Power Engineering

SEPTEMBER, 1952

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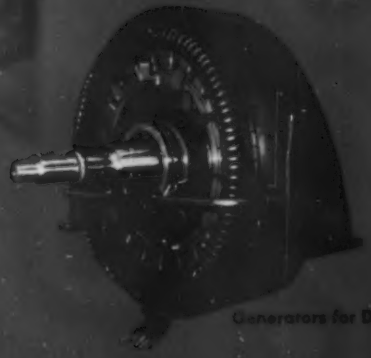
TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

ELLIOTT
equipment for power and process

Deaerating Heaters

Condensers



Generators for Diesels

Turbine Generators

Large Motors

Centrifugal Blowers

Tops in

HERE'S WHY

this Elliott turbine is the natural choice among men who demand sound performance with low maintenance:

AIRWALL LABYRINTH SEALS WITH NO RUBBING CONTACT protect bearings against dust, fly ash, etc.—

CENTERLINE SUPPORT assures constant alignment at all times, irrespective of possible expansion due to temperature changes—

PACKING GLANDS REMOVABLE without raising upper half of turbine casing—

SHAFT IS SPRAY-COATED WITH STAINLESS STEEL under the packing gland, eliminating special maintenance after shutdown—

TURBINE BUCKETS AND SHROUD OF STAINLESS STEEL for maximum life and sustained efficiency—

ROTORS DYNAMICALLY BALANCED for smooth operation—

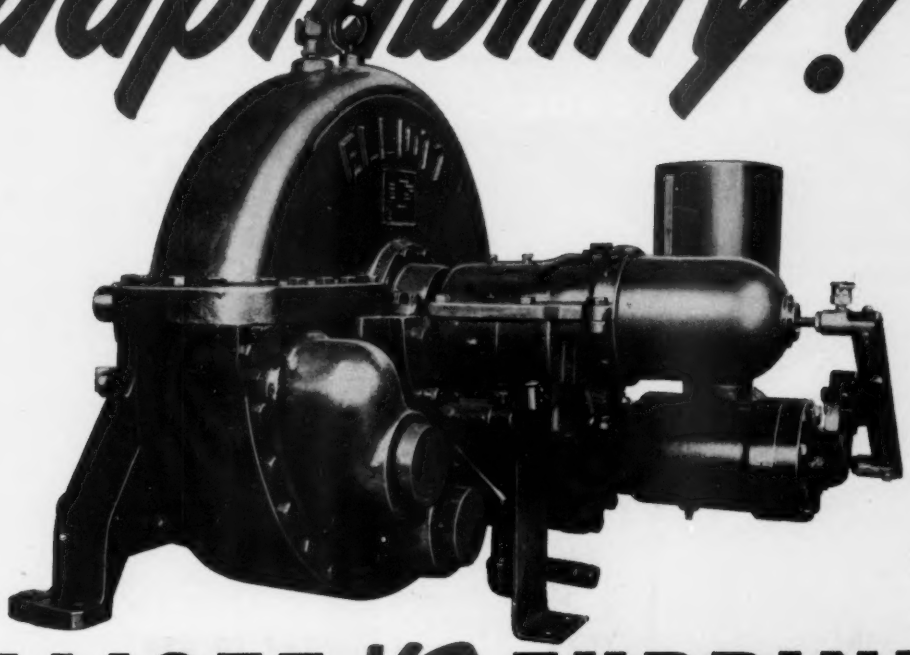
CONSTANT-SPEED GOVERNOR READILY ADJUSTED for permanent speed change—

BUILT-IN STEAM STRAINER of heavy stainless steel and

STANDARDIZED PARTS that fit all YR Turbines, greatly reducing parts inventory.

Bulletin H-16 has the full story. Phone or write your nearest Elliott office.

adaptability!



ELLIOTT YR TURBINE

HERE'S WHY ***this popular turbine can be adapted to practically any operating conditions:***

- **Six elective control devices, including:**
  1. *Two handvalves controlling nozzling*
  2. *Hand-operated speed changer*
  3. *Remote control speed changer, air or electric*
  4. *High exhaust-pressure trip*
  5. *Remote control electrical trip*
  6. *Hand throttled emergency trip valve.*
- **Five frame sizes**
- **Eight different turbine types**
- **Your choice of several governors each independent of the standard overspeed governor**
- **Gland seal piping for condensing operation, or operation with gas**
- **Exhaust connection on either side**

ELLIOTT Company Q2-5

Steam Turbine Dept. • **JEANNETTE, PA.**

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

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Armstrong forged steel compound traps draining steam purifiers at 85,000 lb/hr boiler.

Armstrong cast semi-steel compound trap draining coils of large storage type hot water heater.

. . . it pays to use ARMSTRONG COMPOUND STEAM TRAPS!

Because:

1. **They provide automatic drainage of condensate** or boiler carryover loads too big for ordinary traps to handle (up to 300,000 lbs/hr).
2. **They are relatively small size**—the No. 237 compound trap is only twice the height and size of the largest Armstrong standard trap, yet has many times the capacity.
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4. **They are simple, dependable and trouble-free**—the inverted bucket pilot mechanism is the same as the mechanism in standard Armstrong traps, proven in thousands of installations. This mechanism plus a simple piston and large main valve is all there is to it. All parts are made of special wear-and-corrosion resistant steels.
5. **They are easy to install.**
6. **They can be completely overhauled without removing from the line.**
7. **They are moderately priced.**
8. **They are guaranteed to give complete satisfaction.**

Your local Armstrong Representative is fully qualified to answer your questions about these traps and their use. Give him a call, or write:

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

SEND FOR *NEW* BULLETIN

For complete information ask for 8-page bulletin, No. 215 . . . explains and illustrates operation and installation of Armstrong Compound Traps; includes physical data and list prices. Free on request—no obligation.

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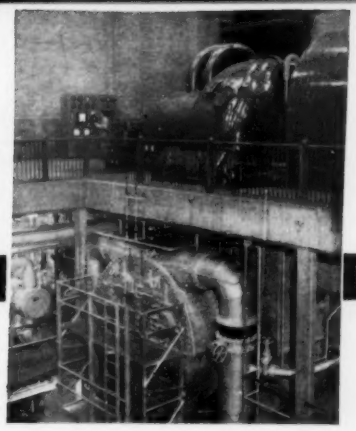

Allis-Chalmers 20,000-kw, 3600-rpm turbine-generating unit at Ohio River Station

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The only magazine devoted exclusively to the job interests of power engineers

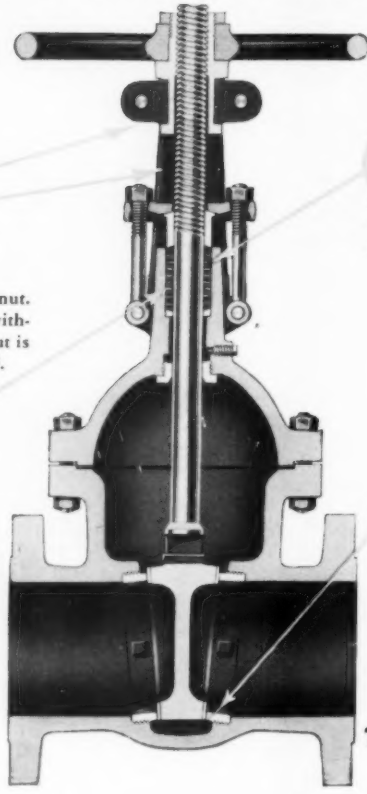
"BUILT TO THE SAME SPECIFICATION STANDARDS – I THOUGHT ALL STEEL VALVES WERE ALIKE AS TWO PEAS"

OIC BUILDS FROM THAT POINT UP

LOOK AT THESE FOUR FEATURES:

1 2–PIECE YOKE DESIGN
simplifies replacement of yoke nut. Permits replacement of yoke nut without shutting down the line. Yoke nut is OIC Alloy 40; non-galling material.

2 STUFFING BOXES
have greater depth than is specified, permitting the use of 7 to 9 rings of packing, with either wiper rings or condensing chamber below.



3 OIC'S SEAL–EVER PACKING
(exclusive with OIC) lasts 10 to 15 times longer than ordinary packing. It stops pitting and corrosion of stems.

4 SEAT RINGS
are end-seated and are subjected only to compression forces when valve is closed; no loosening of seat rings with repeated opening and closing of the valve. No open spaces to cause turbulence, accumulate dirt and hasten corrosion.

THE BEST STEEL VALVE YOU CAN BUY

This combination involving yoke design, stuffing boxes, packing and seat rings is evidence of OIC's desire to build *beyond* minimum specifications.

THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

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FOUNDED 1883

VALVES
FORGED AND CAST STEEL · IRON · BRONZE

ENGINEERS' PREVIEW

EIGHTH ANNUAL National Conference on Industrial Hydraulics, will be held September 4 and 5 at the Sherman Hotel, Chicago, Ill.

The conference, sponsored by Illinois Tech, will be held in conjunction with the Centennial of Engineering.

Highlight speeches will be given by Dr. John T. Rettaliata, president of Illinois Tech, and Dr. R. C. Binder, professor of mechanical engineering at Purdue University.

Dr. Rettaliata's talk will be on "Cooperating with Industry." "Educating the Hydraulic Engineer" will be the subject of Dr. Binder's address.

Twenty technical papers will be presented. They will include discussions in these fields: Automotive, Instrumentation, Pumps, Machine Tools, Air Craft, Hydro Power, Hydraulic Presses, Tractive Equipment and Materials Handling, and Accessories.

Societies cooperating with the conference include the Illinois section of the American Society of Civil Engineering, Chicago section of the American Society of Mechanical Engineers, Chicago section of the Society of Automotive Engineers, Western Society of Engineers, American Society of Lubricating Engineers, Chicago section of American Institute of Chemical Engineers, Chicago section of the Institute of Aeronautical Sciences, American Society of Agricultural Engineers, Chicago chapter of the Illinois Society of Professional Engineers, and the Chicago chapter of the American Society of Tool Engineers.

★ ★ ★

A. W. PAYNE will retire as Chairman of the Board of Directors of Crane Packing Co., after more than 30 years active participation. Frank E. Payne, formerly president of the company, was elected Chairman of the Board and Karl V. Rohlen succeeded to the presidency from his former position of Vice-President and General Manager.

★ ★ ★

NORTHERN EQUIPMENT DIVISION, Erie, Penn. and Vulcan Soot Blower Division, DuBois, Penn. will be merged into Copes-Vulcan Division, Continental Foundry & Machine Company with factory and general offices at 939 West 26th Street, Erie 4, Penn.

Principal products include Copes boiler feed water regulators, desuperheaters, pressure reducing valves and other boiler controls as made and sold for many years by Northern Equipment, and Vulcan soot blowers of all types for the mechanical cleaning of boilers.

With the new plant providing almost twice the total space used by the two former divisions in their old locations, there has been a substantial expansion and modernization of facilities for engineering, research and manufacturing.

★ ★ ★

COLUMBIA UNIVERSITY group will develop plans for a Russian-English Scientific Dictionary under a National Science Foundation contract. During and since World War II, Russian scientific and technical vocabulary has expanded considerably and English speaking scientists have increasingly felt the need for more adequate specialized dictionaries than are now available.

This project will be under the direction of Dr. V. Rojansky, Department of Physics, Union College.

★ ★ ★

M. E. ZIEGENHAGEN has been named Advertising and Sales Promotion manager of Worthington Corporation, Harrison, N. J. This announcement was made by T. J. Kehane, General Sales Manager and assistant Vice President.

Ziegenhagen has been associated with General Electric Co. since his graduation from the University of North Dakota in 1937 where he was awarded a B.S. degree in Mechanical Engineering.

★ ★ ★

ROBERT A. BURNS, JR., will be appointed manager of employee relations for the newly-established Employee Relations Section of the General Electric Company's Medium Steam Turbine, Generator and Gear Department at Lynn, Mass., A. T. Chandonnet, general manager of the department, announced.

Mr. Burns joined General Electric in 1942 and was assigned to production work in the Supercharger Department. In 1944 he transferred to the Labor Relations Department, where he has been employed for several years.

EIGHTH ANNUAL National Electronics Conference will convene September 29, 30 and October 1, 1952 at the Sherman Hotel, Chicago.

Greatly expanded technical program offers 99 papers covering a broad field of Electronic Research, Development, and Industrial Application and is supplemented by over 75 exhibits by manufacturers and institutions foremost in the electronics field.

The conference is sponsored by the American Institute of Electrical Engineers, Illinois Institute of Technology, Institute of Radio Engineers, Northwestern University, University of Illinois with Purdue University, University of Wisconsin and the Society of Motion Picture and Television Engineers participating.

Advance registration may be made by writing to National Electronics Conference, Inc., Karl Kramer, Executive Secretary, 852 East 83rd Street, Chicago 19, Illinois.

★ ★ ★

LAMPS ranging from those used by the Romans to the latest electrical marvels, including the world's largest and smallest, will be featured during the Chicago Centennial of Engineering in September.

The lamps are part of the General Electric Company's "History of Light" display which opened July 21 at the Museum of Science and Industry, Chicago, Ill., in connection with the Centennial program.

The world's largest light bulb, which is 36 in. high and 20 in. in diameter, will be turned on automatically every five minutes during the day. The lamp uses enough electric energy to supply the lighting needs for 40 average homes or to power the largest broadcasting station.

Contrasted with it will be the smallest lamp, a "grain of wheat" lamp used in medical instruments. It is only five-sixteenths of an inch long and is 7/10,000 of an inch thick.

Architect's drawing of the new Copes-Vulcan Division plant where Copes control systems and Vulcan soot blowers will be manufactured. This building will house engineering, research and manufacturing

The exhibit was planned especially not only to educate the thousands of Museum visitors but to "document the very great progress made by man in improving the lighting by which he lives."

* * *

RALPH M. WATSON will now be Director of Research for Worthington Corporation, according to an announcement by H. A. Feldbush, Vice President in charge of Engineering. He assumed the post after the retirement of Paul Diserens July 1st.

Watson joined the Worthington organization in 1936 as an engineer in the refinery pumps section of the Centrifugal Pump Division in Harrison, N. J. In 1942 he was made chief engineer of that division and in 1945 assistant to the Vice President in charge of Engineering.

He is a member of Tau Beta Pi and the ASME, in which he serves as a member of the Power Test Code Committee on Centrifugal Pumps.

* * *

HELMUT THIELSCH, formerly of the Welding Research Council, will be the new Director of Applied Welding Engineering at Eutectic Welding Alloys Corp.

Mr. Thielsch spent the past three years in charge of preparation of critical correlated literature for research investigators and interpreting engineering reports for practical engineers.

His experience also includes that of Secretary of High-Alloys Committee, Welding Research Council; Research Engineer at Lukens Steel Co.; metallurgist with Black, Sivalls & Bryson, Inc.; and research man at Allis-Chalmers. He is a member of the American Welding Society, American Chemical Society, American Society of Metals, and Eta Kappa Nu, and Sigma Chi.

* * *

GRISCOM-RUSSELL CO. will consolidate its entire executive, administrative, engineering and general sales departments at Massillon, Ohio. It held a "Family Day" early in June to mark the 85th birthday of the Company, and at the same time to signalize the consolidation. The celebration also provided the occasion to award specially designed gold emblems to employees of 25- and 10-year standing.

The Company, which is the largest exclusive manufacturer of heat transfer apparatus, originally moved its manufacturing operations to Massillon in 1912. Last Fall the Company moved its general offices from New York City to Massillon to provide most efficient coordination of the work of all departments.

* * *

KEWANEE BOILER CORP. will be combined with Ross Heater and Manufacturing Co., Inc., also a subsidiary of American Radiator and Standard Sanitary Corporation. The new firm will be known as the Kewanee-Ross Corporation, and will continue to operate as a subsidiary of American-Standard.

The engineering and production processes of the firm are similar to those employed by Kewanee Boiler Corporation. Combining these facilities will allow a scope of operation which was not possible under two separate organizations.

Charles H. Currier, president of Ross Heater and Manufacturing Co., Inc., has been named chairman of the board of directors of Kewanee-Ross Corp. W. Bradford Russell, President of Kewanee Boiler Corp., will serve as President of the new firm.

* * *

GENERAL ELECTRIC COMPANY apparatus — $8,000,000 worth — is being installed at the Chalmette (La.) reduction plant of the Kaiser Aluminum and Chemical Corp. as the sprawling installation aims at becoming the nation's largest aluminum-maker by next year.

Bringing the total value of G-E equipment in the plant to $21,000,000, the new units include nine 20,000-kw steam turbines, station switchgear, and auxiliary motors and control.

Eight of the turbines will supply power for Chalmette's four new potlines, while the other will provide power for plant auxiliaries. The four additional lines will double the plant's originally-designed capacity, jumping it from 200 million to 400 million pounds of aluminum a year.

Previously, G. E. had furnished 80 d-c generators, each developing 1200 kw and driven by natural gas engines, to power two of the original four lines. The other two lines are supplied by five 20,000-kw steam turbines.

With operation expected on the first of the four new lines this year, the expansion is in line with plans to increase the aluminum industry's over-all production to approximately 2½ billion pounds annually.

* * *

SCHOLARSHIPS for study in the fields of science, engineering, or business administration at Cornell University will be established this year by the Rome Cable Foundation, Inc.

The Foundation has appropriated $2,500 for the scholarships this year, and up to $5,000 for next year. The scholarships will be known as the "Herbert Thomas Dyett Scholarships," in honor of H. T. Dyett, founder and chairman of the board of the Rome Cable Corp. Mr. Dyett is an alumnus of Cornell University, class of 1897.

Applications for the scholarships will be accepted from boys graduating from the high schools in Rome, N. Y., and from sons of employees of the Rome plant graduating from any school. Eligible graduates wishing to apply should consult the principals of their schools, or they may obtain the necessary information by writing to John H. Dyett, secretary of the Rome Cable Foundation, Rome, N. Y.

COMMERCIAL FILTERS CORP. is moving into a new ultra-modern factory located on the Malden-Melrose town line, nine miles north of Boston. Effective August first their address will change from 18 West Third St., Boston 27, Mass., to the new one which is Two Main Street, Melrose 76, Mass., telephone — MAlden 4-9250.

* * *

A NEW WING providing increased engineering space has been added to the plant of Leslie Co., Lyndhurst, N. J. The new and larger Engineering Department includes a larger modern drafting room and new test laboratory, which provides added facilities for long range research and development to add new and improved equipment to the Leslie Line.

Also, in keeping with their plans for better service, the J. R. Simpson & Co. with headquarters at 1210 S. 17th Ave., Maywood, Ill. are now the agents for Leslie Regulators. They will serve customers in the northern half of Illinois, and the northwestern counties of Indiana. This location lends itself to better servicing of accounts in the greater Chicago industrial area, as well as those in Chicago proper.

* * *

DESIGN against corrosion and engineering approaches to the solution of corrosion problems will be the principal themes of technical program of **NACE** South Central Region's meeting at New Orleans October 1-3. An outline calling for the presentation of 18 papers in four symposia has been prepared by John E. Loeffler, of Thornhill-Carver Co., Houston, technical program chairman.

Two unusual features have been proposed for the program and both are well under way to complete organization. One is the presentation of a Technical Practices Committee Report by a subdivision of TP-1 on Corrosion of Oil and Gas Well Equipment. The other will consist of four discussions of corrosion work done by other petroleum industry associations and the relation of the work of these other groups to similar work in the NACE.

* * *

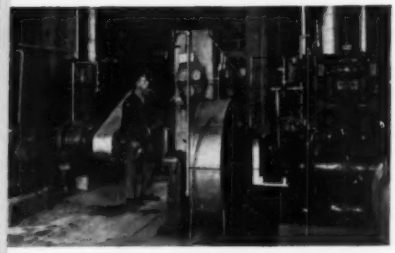
ROBERT F. TINNERHOLM, general manager of the Switchgear Department of the General Electric Company, Philadelphia, Pa., will retire after 40 years of service with the company on September 1.

Mr. Tinnerholm joined G. E. in 1907 as a drafting apprentice in Schenectady and was graduated from the apprentice course in 1911. He became affiliated with the switchgear business in 1919 as a proposal engineer in Schenectady after returning from service in World War I. He was named general manager of the Switchgear Department in October 1947.

George E. Burens, general manager of the company's Switchgear and Control Division, will serve as acting general manager of the Switchgear Department.

450 TONS OF ICE can be safely stored in this room. All of it is needed for concessions at Hershey Park and for domestic consumption. The supply is always dependable, thanks to Suniso.

THE HERSHEY BEARS AVERT A SCORE. The ice for this sports arena has been supplied with the help of a Suniso Refrigeration Oil for about six years. With a previous oil, compressor breakdowns were a constant threat to the sports program.



TEMPERATURES FROM −50F to +50F are supplied by these Frick ammonia compressors. They circulate brine through coils in the ice plant and under the arena floor, and ammonia through coils in the cooling and quick-freezing rooms. One grade of Suniso lubricates all of these compressors. Overall efficiency has been 15 percent better ever since its adoption.

COMPRESSOR EFFICIENCY BOOSTED 15% BY SUNISO

The refrigeration compressors which service the Hershey Sports Arena, home of the Hershey Bears, are part of a central system which also takes care of an ice plant, frozen food lockers and cold storage rooms. About six years ago, the compressors were losing efficiency because of an inadequate refrigeration oil. It formed excessive lacquer and carbon deposits, which clogged the lines and made frequent overhauls necessary.

To solve the problem, management called in a Sun representative, and on his advice switched to a Suniso Refrigeration Oil. Suniso's natural detergency immediately began attacking the deposits throughout the system, carrying the sludge to traps and filters. Soon the system was entirely clean. Since then—over six years ago—the compressors have run at an overall added efficiency of 15 percent, and have always been equal to the heavy requirements made of them.

75 TONS OF PEACHES AND APPLES are stored at 31 F to 35 F. Nearby are cold rooms protecting potatoes, cheese and raisins at 38 F to 40 F, powdered milk for chocolate at 40 F; a quick-freeze held at −40 F to −50 F; frozen food storage at −6 F to −8 F. These rooms are all serviced by the same central system which handles the arena and ice plant.

SUN OIL COMPANY, Dept. PO-9, Philadelphia 3, Pa.

If faulty lubrication is possibly costing you compressor efficiency, use this coupon to get: ☐ the services of a Sun representative, ☐ a free copy of the technical bulletin "Lubrication of Refrigeration and Air Conditioning Equipment."

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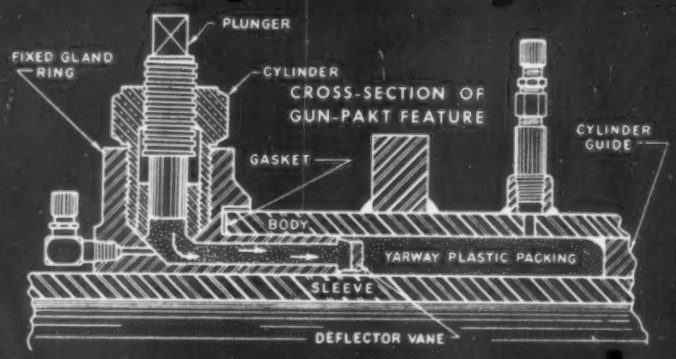
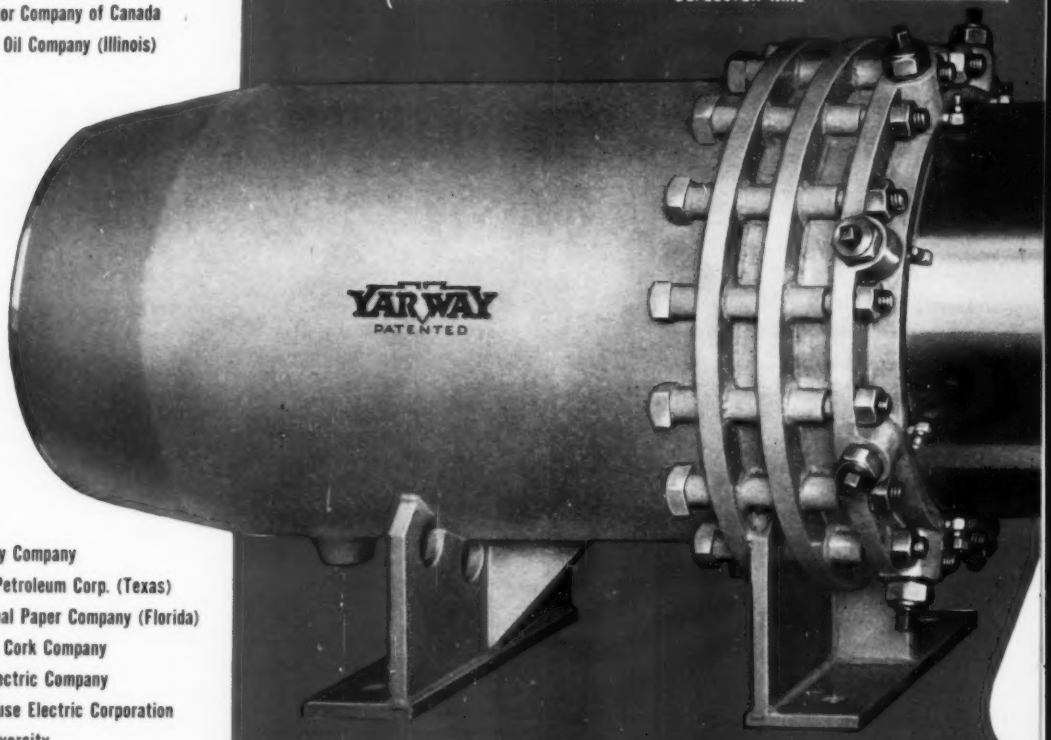
this expansion joint





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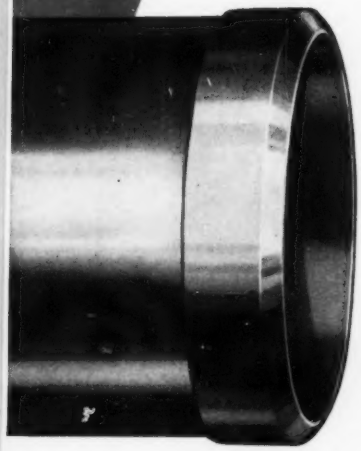

Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineering. Its success is shown by wide use in leading central heating stations, institutions and industrial plants.

Get the full Gun-Pakt story . . . get Yarway Bulletin EJ-1912. Write to . . .

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114 Mermaid Avenue, Philadelphia 18, Pa.

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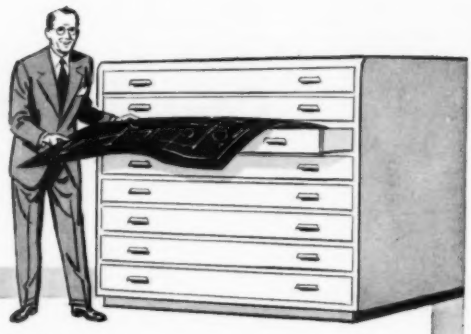
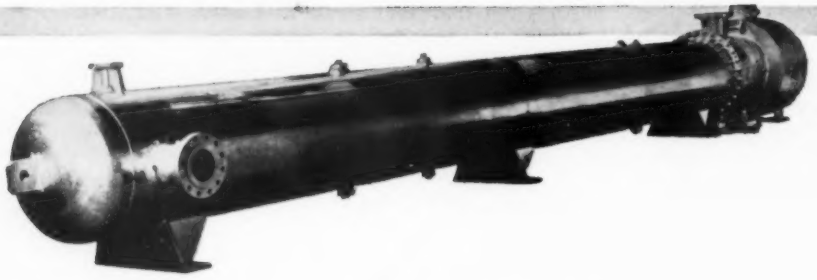
U-Tube
Horizontal
Vertical
Condensing
Subcooling
Desuperheating
High Pressure
Low Pressure
Large Capacity
Small Capacity



at our finger-tips

the right feedwater heater design for your needs



No matter what may be your capacity needs, your boiler pressure, your plant heat balance, or your special operating conditions, you can be sure that G-R can supply a practical, effective design of feedwater heater precisely suited to your needs.

That's because of the 65 years of G-R experience in building feedwater heaters, throughout which the G-R designs have been steadily developed to keep abreast of advances in steam plant practice.

And here's another important result of this unequalled G-R experience . . . the many proven exclusive design features that assure long, economical service as well as highly efficient heat transfer.

Write for bulletin describing in detail the many types and advantages of these units.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS *Feedwater Heaters*

GR 252

ALL FORGED STEEL

Edward

INSTRUMENT VALVES

Lowest Cost Valves for Their Rating!

Standardize on Edward instrument valves—forged steel, yet their price is comparable to ordinary bar-stock valves.

Edward instrument valves are top-quality in every design detail—easy-grip T-handle . . . bronze yoke bushing . . . forged steel one-piece outside screw yoke . . . forged steel corrosion-resistant EValized packing gland . . . EValloy 13% chromium stainless steel stem-disk with needle point for close flow control . . . forged steel EValized gland bolts that swing out of the way for easy repacking . . . heat resistant die molded EValpak packing.

And look at this versatility—

★ STEAM, WATER, OIL or GAS PRODUCT PROCESS LINES

Edward instrument valves fit into any piping system. Globe or angle, sizes ¼", ⅜", ½", ¾" and 1".

★ HIGH TEMPERATURES or HIGH PRESSURES

Rated up to 6000 lb at atmospheric temperatures, or up to 1500 lb at 1000 F.

★ STANDARD or CORROSIVE SERVICE

Available in carbon steel or 13% chromium bodies and trim.

★ TYPICAL USES

Orifice Meters	**Regulators**
Instrument Panels	**Gage Lines**
Oil Field Xmas Trees	**Drip and Drain Lines**
Hydraulic Systems	**Pressure Recorders**
Vent Lines	**Corrosive Lines**

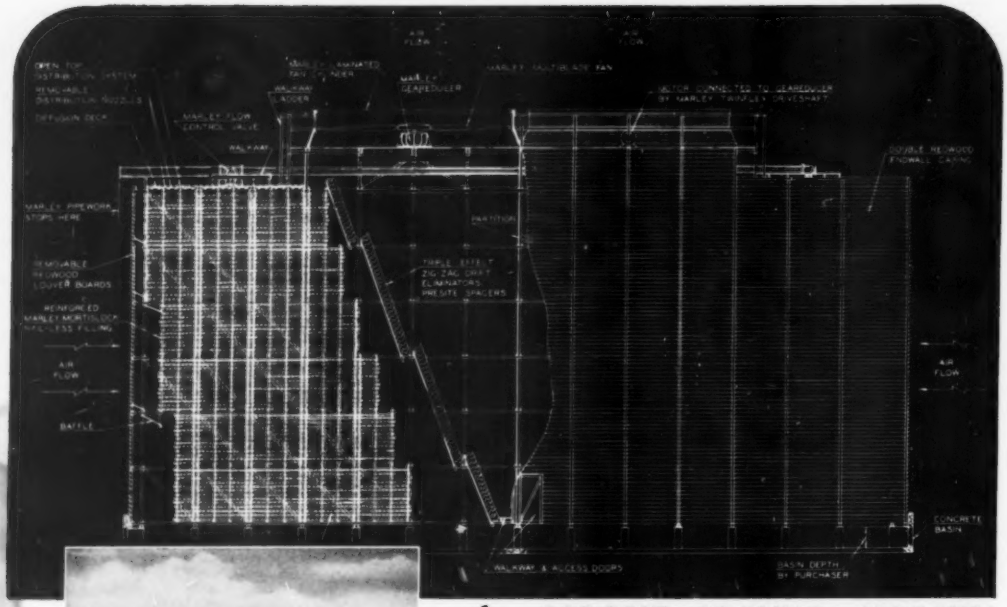
Get the full story on Edward instrument valves—*the lowest cost valves for their rating.* Write for Bulletin 491.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

220 WEST 144TH ST. EAST CHICAGO, INDIANA

Another Product



for LARGEST COOLING CAPACITY with LIMITED TOWER AREA

Engineers who know, choose MARLEY Twin-Flow

Twin-Flow cooling towers concentrate maximum cooling ability in every square foot of plant area . . . make fullest utilization of the many exclusive advantages of Marley cross-flow cooling. That's why they deliver largest quantities of cold water at economical cost per gallon.

High, louvered sides provide even air flow throughout all parts of the patented Marley filling that breaks up the water most completely and at closest intervals. This long, thorough air-water contact means performance —the ability to cool more water to lower temperatures.

Twin-Flow design includes Marley open distribution for at-a-glance inspection, simplified maintenance and safety for operators. All mechanical equipment is Marley designed and manufactured exclusively for cooling tower service and is field-proved in thousands of installations. Marley structural strength that means long service life is a fundamental of Twin-Flow engineering.

Marley Application Engineers in fifty cities will gladly show how Twin-Flow cooling towers can bring added economy to your plant.

producers of

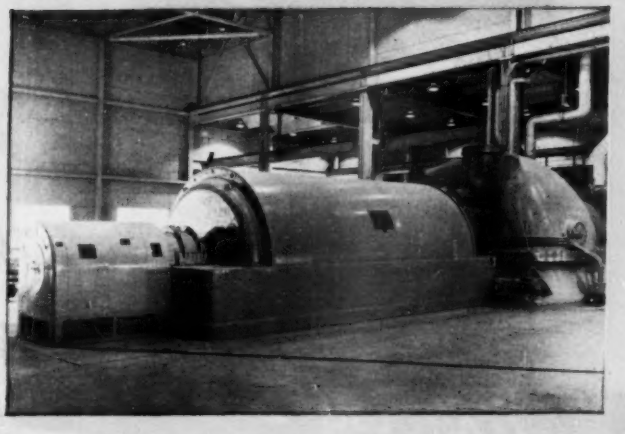
DOUBLE-FLOW TOWERS
AQUATOWERS
DOUBLE-FLOW AQUATOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.

KANSAS CITY 5, MISSOURI

"Major power companies now specify inhibited turbine oils"



. . . and here's why so many of them choose SHELL TURBO OIL

Shell Turbo Oil exceeds every accepted specification for premium turbine lubricants. These are the notable qualities:

1. HIGHEST ATTAINABLE RUST PROTECTION

An effective *combination* of rust inhibiting additives goes to work at the source of rust formation. Rust problems are reduced to the very lowest level.

2. COMPLETE OXIDATION STABILITY

The anti-oxidant in Shell Turbo Oil has so far defied improvement! It provides outstanding oxidation stability and thereby minimizes sludge formation.

3. ANTI-FOAMING

The anti-foam agent used is so effective that air entrainment can be tolerated for considerable periods—avoiding unscheduled shutdowns.

4. EXCELLENT EMULSION CHARACTERISTICS

Shell Turbo Oil's remarkable protection against rust and oxidation is attained with the minimum tendency to formation of water emulsions in service.

5. PROTECTION AGAINST WEAR

The inhibitive agents in Shell Turbo Oil *add* to the wear-reducing qualities of the specially refined oil itself, an extra margin of safety for the bearings during critical starting periods.

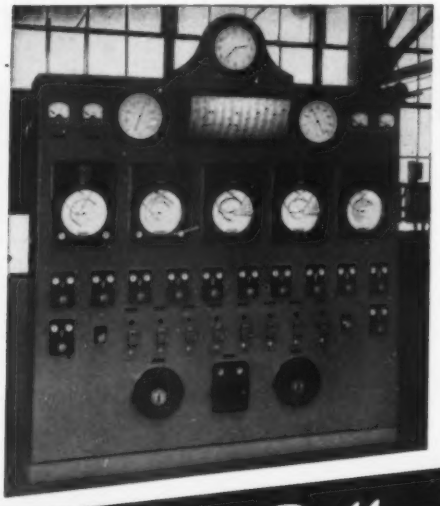
We'll be glad to give you the full story on Shell Turbo Oil, with specific recommendations for your own generating units.

SHELL OIL COMPANY

50 West 50th Street,
New York 20, New York,
or 100 Bush Street,
San Francisco 6, California.

SHELL TURBO OIL

SHELL



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

DRAW A BEAD ON BOILER CARRYOVER

CARRYOVER refers to the entrainment of boiler water in the steam from any source, especially when it is due to foaming, priming or other causes. No matter what "IT" is called, anything other than dry steam going over from the boiler may lead to difficulties!

Use DREW POWER CHEMICALS

Almost all suspended and soluble materials in your boiler water system contribute to Carryover. They may lead to expensive trouble in boiler, steam and condensate lines and equipment and processes using steam. It's the duty of every good water treatment company to recognize and solve this problem.

Draw a bead on Carryover! Call the Drew engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew laboratories. You'll be given specific recommendations for corrective and preventive treatment . . . involving the use of Organics or Anti-Foams where necessary. And you'll receive continuous and frequent service, too!

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer, or write for information.

Power Chemicals Division

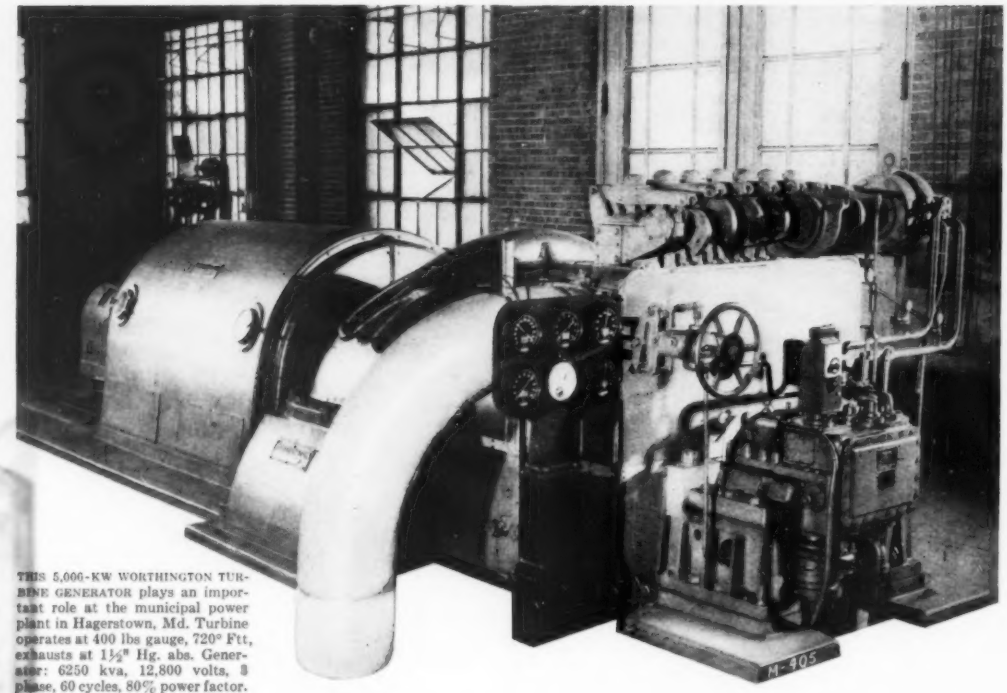
E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS
AJAX, ONTARIO

Service throughout the United States, Canada and South America

DREW PRODUCTS



THIS 5,000-KW WORTHINGTON TURBINE GENERATOR plays an important role at the municipal power plant in Hagerstown, Md. Turbine operates at 400 lbs gauge, 720° Ftt, exhausts at 1½" Hg. abs. Generator: 6250 kva, 12,800 volts, 3 phase, 60 cycles, 80% power factor.

WORTHINGTON turbine generator at City of Hagerstown, Md. completes second year of continuous operation

A little over two years ago Hagerstown, Maryland, took one of the biggest steps in its $1,500,000 post-war power-plant expansion program. They installed and began operating a 5,000-kw Worthington turbine generator unit.

Fulfilling the reputation for reliable performance held by all members of Worthington's team in steam, this power supply has run continuously since installation.

Hagerstown is just another of the many Worthington users that are reaping the rewards of the experience and specialized engineering that go into the manufacture of these long-life, ever-dependable turbine generators.

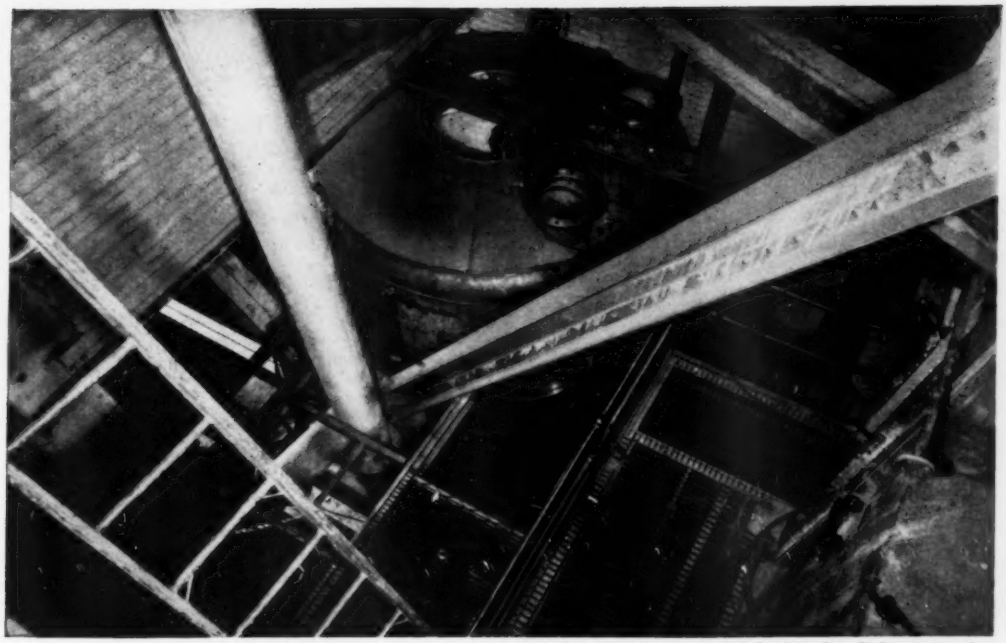
Keynote of Worthington's service reliability is the advantage you get because Worthington turbine generators are designed, assembled and tested for combined operation—as a complete unit—*before* shipment. Built in sizes up to 10,000 kw, the performance records of these machines are added proof that *there's more worth in Worthington*. For detailed information, consult your nearest Worthington representative or write to Worthington Corporation, Steam Turbine Division, Wellsville, New York. T.1.11

SINGLE-STAGE TURBINES | MULTI-STAGE TURBINES | TURBINE-GENERATOR SETS | FEED WATER HEATERS | BOILER FEED PUMPS | SURFACE CONDENSERS

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbine Generators



STAINLESS STEEL DEAERATING TANK is hoisted in place during construction of one of Detroit Edison Company's Heating Plants at Detroit, Michigan.

When CO_2 Caused a Headache ...Worthington Cured It

Detroit Edison had the solution to its problem —the problem of CO_2 in its steam—except for one thing.

Zeolite-softened municipal water used in their steam plant contains high percentages of carbonates which decompose and generate CO_2 in the boilers. Carried over with the steam into heating and processing equipment, that CO_2 could cause plenty of trouble.

The CO_2 problem was solved by Detroit Edison engineers by acid treating the softened water, converting the carbonates to CO_2. The gas thus formed is driven off in a deaerator.

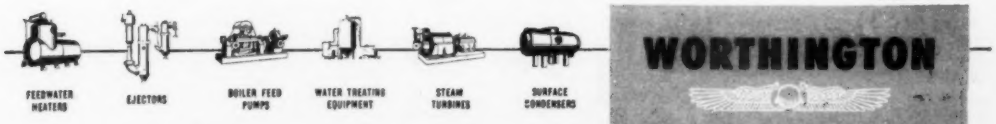
However, no standard deaerator could successfully remove the large quantities of CO_2 released by the acid treatment, and deliver water to the boiler with practically zero oxygen and zero CO_2. Furthermore, standard materials would have lasted only a few months under such conditions.

NON-CONTAMINATED STEAM

Worthington provided the answer. Detroit Edison engineers selected a Worthington deaerator specially designed for these severe conditions, built entirely of stainless steel, and guaranteed to deliver water containing not over 0.005 ppm of oxygen and not over 0.1 ppm of CO_2. The result is steam containing so little CO_2 that the amount *cannot be accurately measured!*

On problems like this one, Worthington not only furnishes *all* of the equipment needed in a complete water treating installation, but also has the engineering ability to work with your engineers on the *complete* problem of generating steam for power or processing. For further information on why *there's more worth in Worthington*, address Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

S1.2

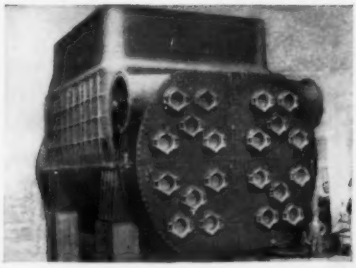


A GREAT TEAM IN STEAM

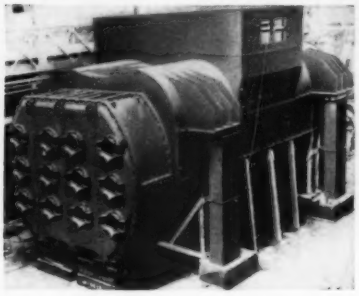
WORTHINGTON

Feedwater Heaters

CON EDISON'S EAST RIVER ELECTRIC GENERATING STATION at 14th Street, New York City, will contain the new Worthington 125,000 sq-ft condenser. The shell, which is to be installed under 160,000-kw Unit No. 7, will contain nearly 105 miles of ¾" O.D. aluminum brass tubes and will require 138,000 gpm of East River water supplied by two 54 in. Worthington "Mixflo" vertical single suction volute circulating pumps.



WORTHINGTON CONDENSER installed in 1931 to serve 160,000-kw Unit No. 7, Hudson Avenue Station. Tube sheets were drilled for 110,000 sq ft with 101,000 sq ft installed.



ONE OF TWO 74,500 SQ-FT 2-PASS WORTHINGTON CONDENSERS serving 60,000-kw Units 14 and 15 at Waterside Station No. 1.

Con Edison once again installs "largest" condenser

On several occasions over the past fifty years, Worthington has been selected to build the "world's largest" surface condensers in single shell design.

In 1919, a 70,000 sq-ft condenser was installed under a 35,000-kw turbine-generator for a prominent utility company. This was the largest single shell surface condenser of its day.

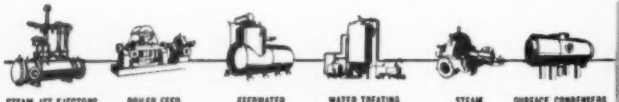
In 1931, Brooklyn Edison Company (now Consolidated Edison Company of New York, Inc.) installed, under 160,000-kw Unit No. 7 at the Hudson Avenue Station, the "world's largest" at that time, a 101,000 sq-ft single-pass Worthington condenser. This was followed, in 1949, by two 74,500 sq-ft condensers for Waterside Station No. 1.

Now, Worthington is again building for Con Edison the "world's largest" single-shell condenser ever ordered, 125,000 sq-ft, single-pass, for the 160,000-kw Unit No. 7 addition to East River Station.

Worthington, with over a century of experience in the manufacture of steam power equipment, is prepared to build efficient condensers in all sizes. Let us advise you, without obligation, on your new installation.

Write, stating requirements, to *Worthington Corporation, Steam Power Division, Harrison, New Jersey.*

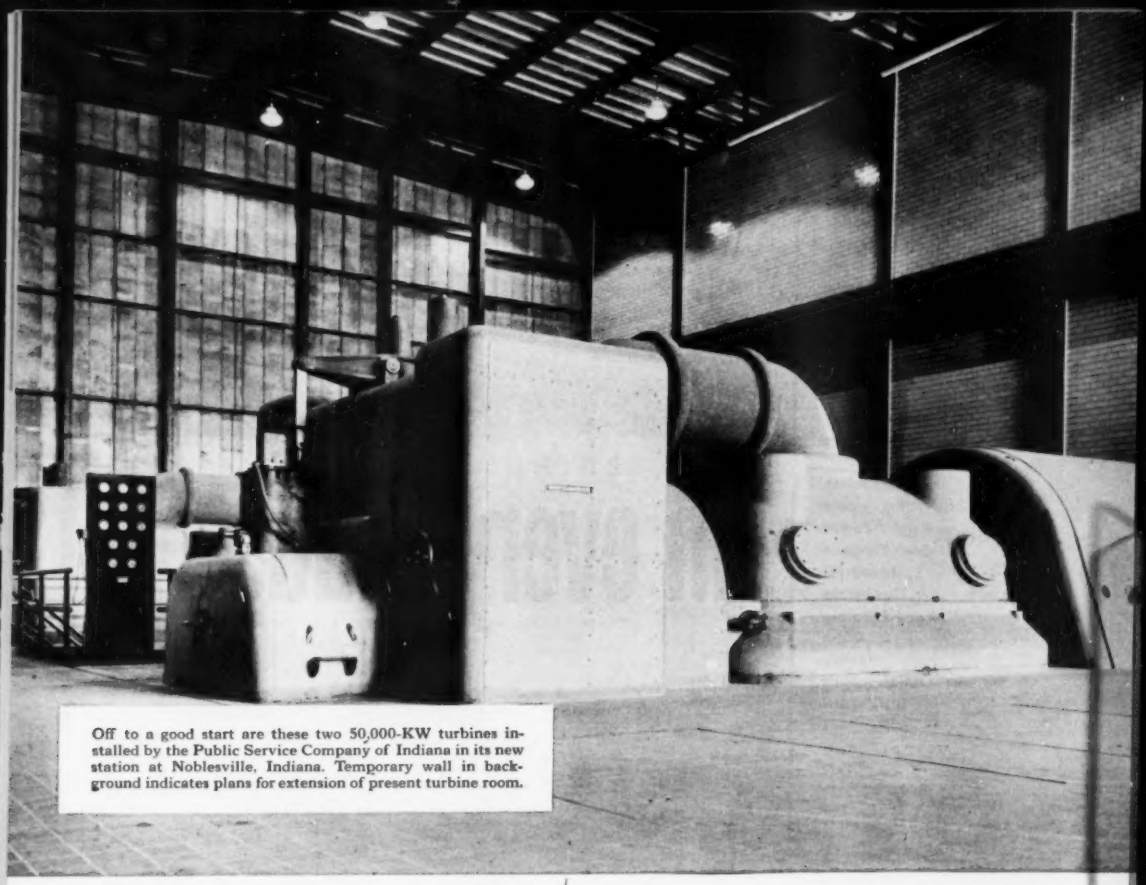
Z.2.2



World's Broadest Line of Steam Power Plant Auxiliaries

WORTHINGTON

Condensers



Off to a good start are these two 50,000-KW turbines installed by the Public Service Company of Indiana in its new station at Noblesville, Indiana. Temporary wall in background indicates plans for extension of present turbine room.

New turbines with the future guaranteed

● When these two 50,000-KW turbines were placed in service recently for the new Public Service Company of Indiana generating station at Noblesville, Indiana, NONPAREIL Turbine Oil was used for the initial fill . . . assuring trouble-free lubrication for the life of the turbines themselves.

With this installation, as with every installation of NONPAREIL Turbine Oil, plant operators received a written guarantee that the oil will last as long as the turbines and will never exceed a neutralization number of 0.15 mg. KOH/gm. Lasting, low-acidity assures that NONPAREIL will not have to be removed for treatment or for cleaning the lubrication system.

For guaranteed lubrication in your own turbines . . . new or old . . . fill with NONPAREIL. A Standard Oil lubrication specialist can show you the facts, including service records covering up to twenty-three years continuous operation of NONPAREIL Turbine Oil. Contact your local Standard Oil Company office. Or write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY

STANDARD (*Indiana*)

Industries served by VU Boilers

Aircraft
Asphalt
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Carpet
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Chemical
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Coke
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Dairy
Department Stores
Distilling
Explosives
Electrical Equipment
Electric Power
Food Products
Foundries
Gas Works
Gelatine
Glass
Hosiery
Knitting Mills
Institutions
Laundries
Leather
Linoleum
Locomotive
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Mining
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Sewage Plants
Shipbuilding
Sugar
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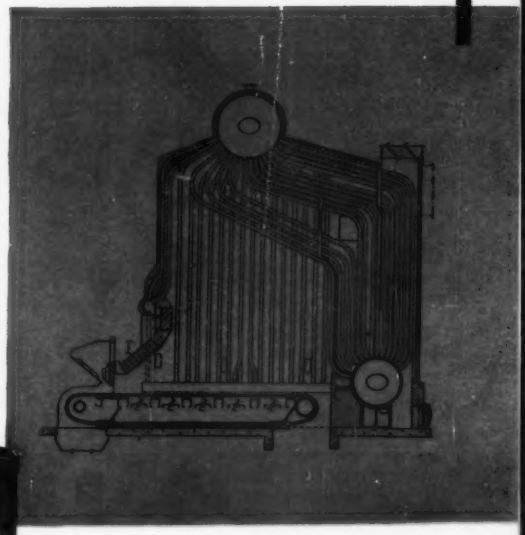
VU—the choice of Leaders in every Industry



VU-10 Boiler — This unit, one of three duplicates, is installed in a food processing plant. It is fired by a chain grate stoker. Capacity — 25,000 lb of steam per hr; operating pressure — 125 psi; no superheat.

C-E

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

Wherever steam is important for power, heating or process — you'll find C-E Vertical-Unit Boilers (Type VU) establishing new standards of reliable, efficient operation. In industry after industry, leading manufacturers are setting the pace with VU Units.

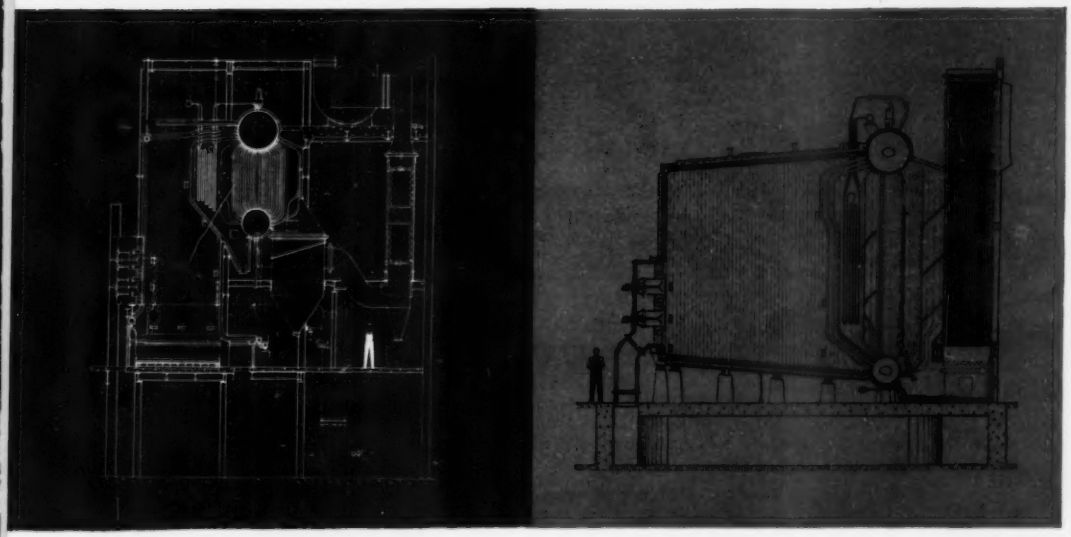
Food and Beverage companies are typical examples of the widespread acceptance Vertical-Unit Boilers find in industries everywhere. Many of the leading food processors, as shown below, are consistent users of VU Boilers.

But why list only the larger companies, when so many VU Boilers are used in smaller plants? Chiefly because the practices of the big companies form a helpful buying guide. Large companies buy boilers frequently so their experience is always up-to-date. They buy them for different plant locations and for a variety of operating conditions. Thus, they have the accumulated knowledge and broad experience needed to make sound boiler selections.

You can profit from this industry's experience — or from that of any industry that has large steam requirements. So if you need reliable, low-cost steam in any amount ranging from 10,000 to 350,000 pounds per hour, it will pay you to investigate the advanced design ... sound construction ... proved reliability of C-E Vertical-Unit Boilers. B-598

Leading Food and Beverage Companies using VU Boilers in one or more plants

American Maize Products Co.
American Sugar Refining Co.
Anheuser-Busch, Inc.
Armour & Co.
J. E. Brach & Son, Inc.
Curtis Bros.
General Foods Corp.
H. J. Heinz Co.
Penick & Ford, Ltd., Inc.
Joseph Schlitz Brewing Co.
W. F. Schrafft's & Sons, Inc.
Spreckels Sugar Co.
Sunshine Biscuits, Inc.
Swift & Co., Inc.
Wm. Wrigley, Jr., Co.



VU-40 Boiler — This unit is installed in the plant of a food product company. It is fired by oil; arranged for future pulverized coal. Capacity — 60,000 lb of steam per hr; operating pressure — 250 psi; steam temp. 600 F.

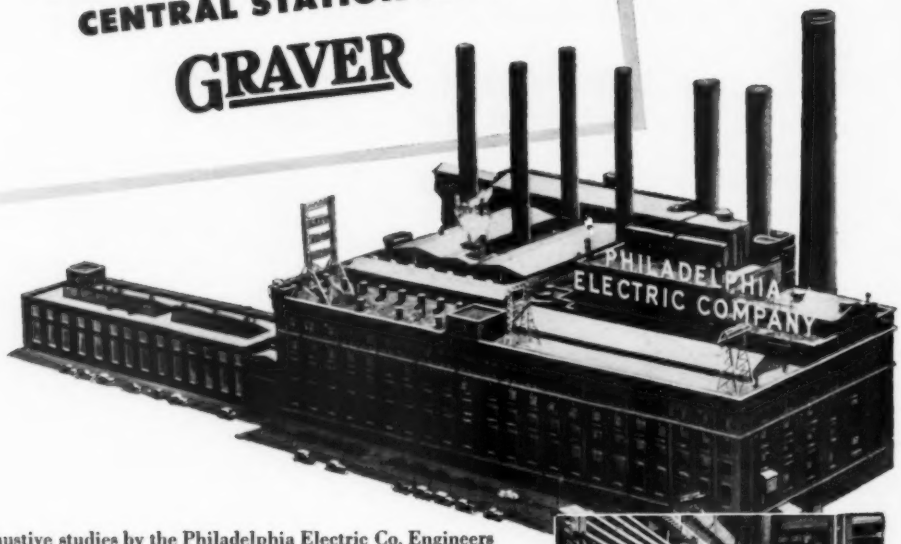
VU-50 Boiler — This unit is one of two duplicates installed in a brewery. They are fired with oil or gas. Capacity — 100,000 lb of steam per hr; operating pressure 550 psi; steam temperature 700 F.

—SUPERHEATER, INC.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

The Largest Demineralizer

USED IN A PUBLIC UTILITY CENTRAL STATION IS A GRAVER



Exhaustive studies by the Philadelphia Electric Co. Engineers of all water purifying methods and equipment designs led to the selection of a Graver Demineralizing plant for the Schuylkill Station.

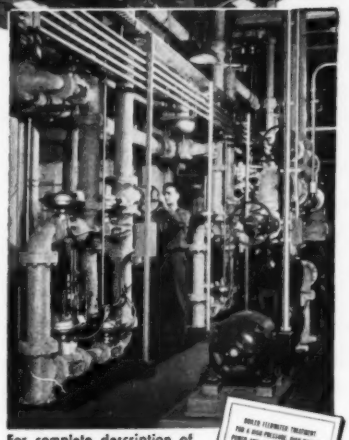
The requirements . . . . . boiler feed make-up 1250 gpm for 1250 psig boilers.

The purpose . . . to supply heating needs in downtown Philadelphia, serving 600,000 lb per hr make-up to high pressure boilers and topping turbines.

The Graver plant has been in operation since late 1950. Typical of Graver performance and guarantees are the following results:

	Raw Water	Graver Guarantee	Graver Performance
Dissolved Solids, ppm	**220**	**less than 8**	**1.5-2.0**
Silica, ppm	**13**	**less than 0.3**	**0-0.2**

Doing better than expected is a Graver habit . . . demonstrated by all types and sizes of Graver Water treatment plants. To make sure that *you* have "better than expected" results, consult Graver about *your* water problem.



For complete description of this demineralizing plant, write for free technical article "Boiler Feedwater Treatment for a High-Pressure, High Make-up Power and Steam Producing Plant".

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

DEPT. PE-D, 216 WEST 14TH STREET, NEW YORK 11, N. Y.

IN CANADA: The Bird-Archer Co., Ltd.; Cobourg, Ontario

IN MEXICO: Proveedores Tecnicos, S.A.; Puebla 259, Mexico 7, D.F.

GRAVER

GW 459

Whatever your fuel picture, *there's a B&O coal to fit it!*

• In the Baltimore & Ohio area lies a treasure-land of Bituminous—an almost inexhaustible source of low-cost heat and energy. Here are found Bituminous coals *of all varieties*—for power, for coking, for steam, for space heating.

B&O coals are excellent for generating steam in utility and industrial power plants, for steel mills, malleable iron plants, gas plants, lime and brick kilns, cement and glass plants, and potteries.

Whatever your "burning need," Industrial or Domestic, there's a B&O coal to meet it—and we are ready to help you find the best for your purpose. Just *ask our man!*

BITUMINOUS COALS FOR EVERY PURPOSE

LINKING 13 GREAT STATES WITH THE NATION

BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!

BEFORE—Johnson-March system turned off at car dumper of a large midwest utility. Compare this unretouched photo with the one at the right.

AFTER—Note absence of dust when Johnson-March system is operating at this same dumper. These systems have proved themselves in many plants. We'll be glad to furnish names.

STOP COAL DUST

at 1/10 the usual cost!

If you have a dust problem—no matter how large or small—no matter where the dust occurs . . . car dumpers, hoppers, crushers, belt galleries, or coal pile—it can be controlled or eliminated with a Johnson-March liquid diffusion system. Installation is fast, simple, and inexpensive. There is no interference with normal plant operations.

No ducts, no fans and no cumbersome equipment are required. Johnson-March compounds added to water and a carefully engineered spray system do the work. The system is guaranteed effective, but its operation is simple. It costs far less than other types of dust handling systems—in most cases only 1/10 as much. And maintenance costs next to nothing!

Even though you may have a mechanical dust collecting system, it will pay you to investigate a Johnson-March system.

Without cost or obligation, why not have one of our engineers discuss your dust problems with you? Just drop us a line or mail the attached coupon.

THE JOHNSON-MARCH CORP.
1724 Chestnut St., Philadelphia 3, Pa.
Without cost or obligation, I would like to know more about the Johnson-March system of low-cost dust control. PE-3

Name .....
Company .....
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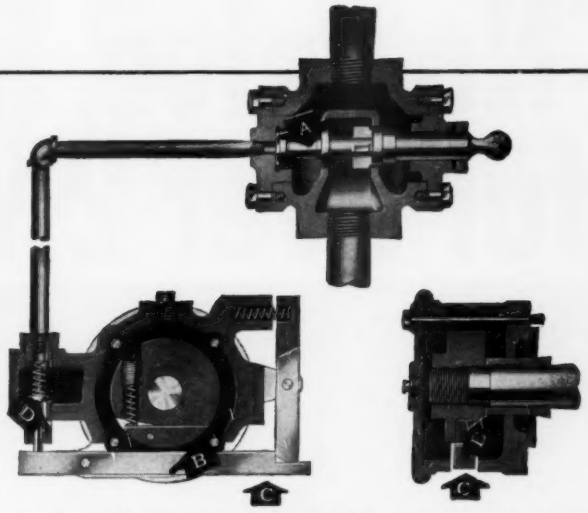
Johnson March

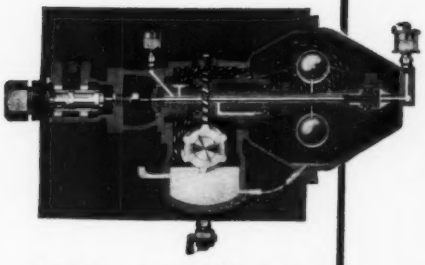
Specialists in Dust Control

1724 CHESTNUT STREET **Philadelphia 3, Pa.**

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

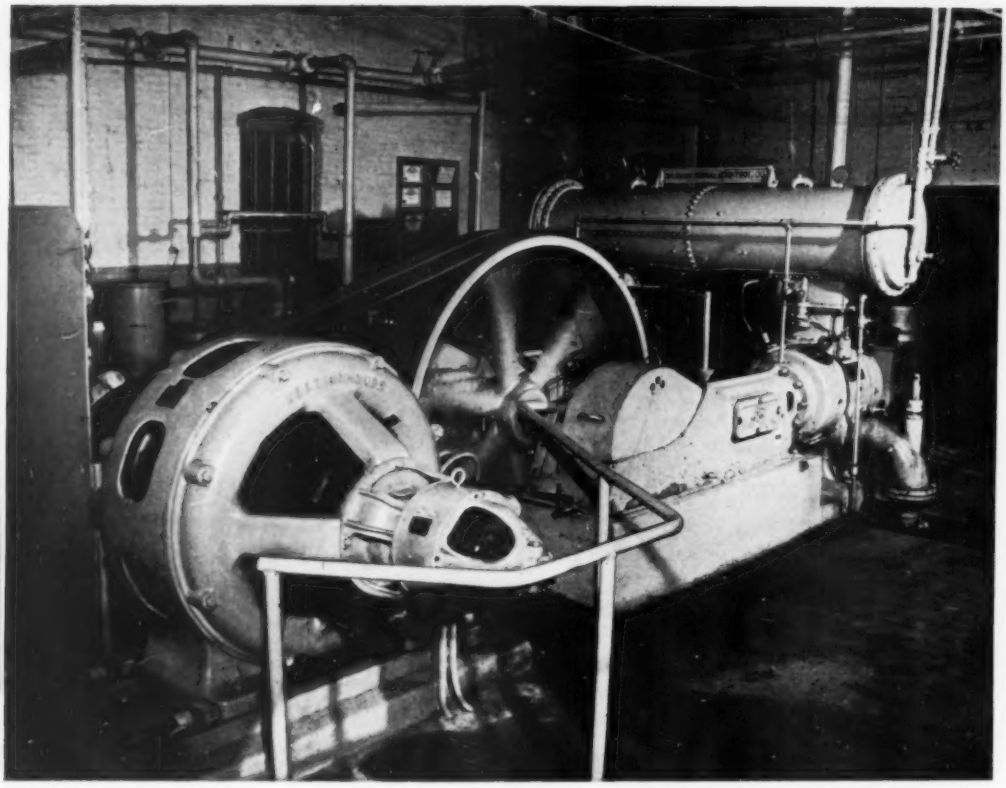
When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 169 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

"No Valve, Ring, or for Over 2 Years!"



The American Car and Foundry Company's huge plant at Huntington, West Virginia has been a user of Sinclair lubricants for over eighteen years. The results are of particular interest!

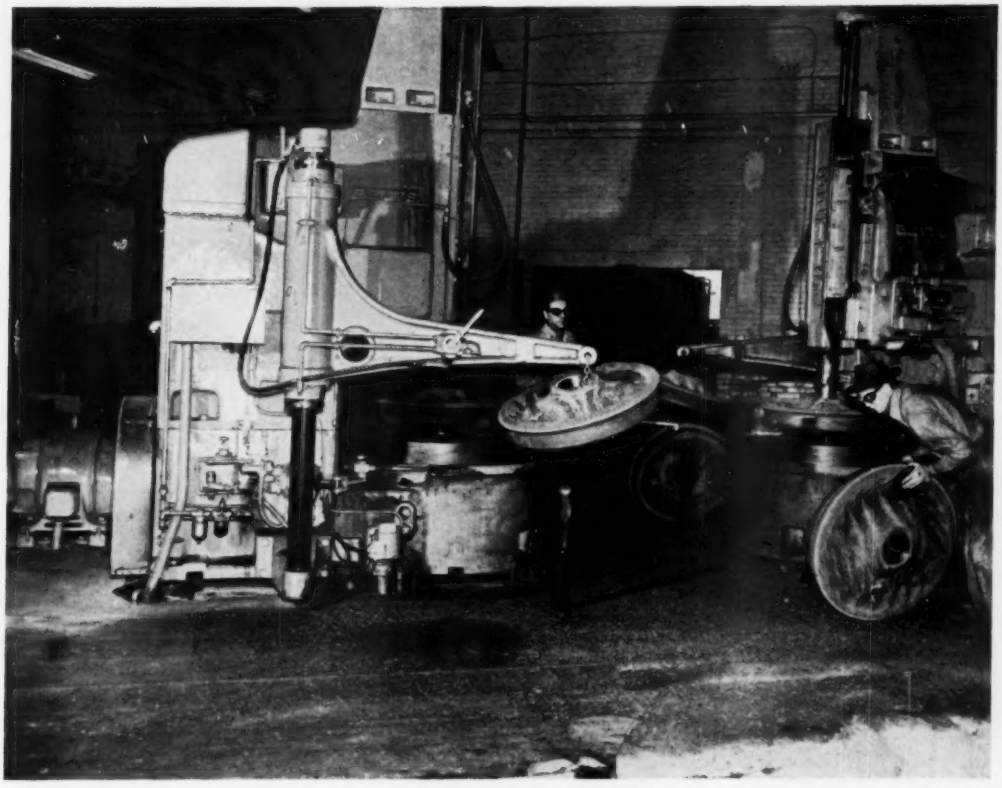
For example – the four compressors in the ACF plant are lubricated with Sinclair RUBILENE Medium. Proof of outstanding lubrication stamina is attested to by this service report: *"None of these compressors has required servicing of valves, rings, or bearings for over two years."*

Results speak volumes for this Sinclair Product. Why not investigate the advantages of RUBILENE Oils, available in *nine* viscosity grades? Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N.Y.

SINCLAIR RUBILENES®

Bearing Service

...SAYS THE AMERICAN CAR AND FOUNDRY COMPANY



"Rubilene has given Trouble-Free Service."

Further proof of RUBILENE quality is found in the operation of two Betts Heavy Duty Hydraulic Feed Car Wheel Bores. The American Car and Foundry Company says, "RUBILENE Oil Extra Light has given trouble-free service as the hydraulic fluid since these machines were put in service. No problem either, with chatter or sticking air hoists—RUBILENE Oil Medium in the air line lubricators does this job admirably."

for low maintenance costs

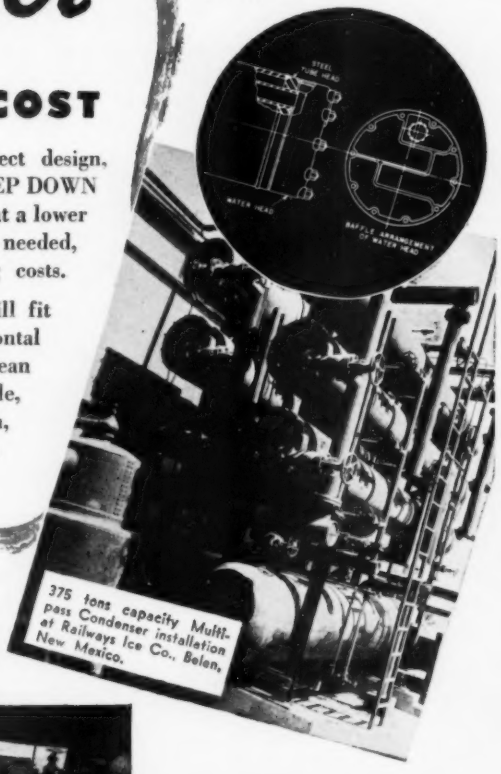
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

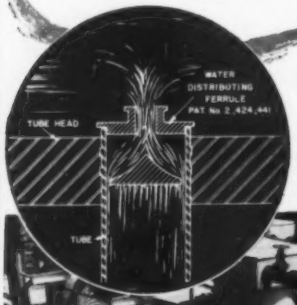
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

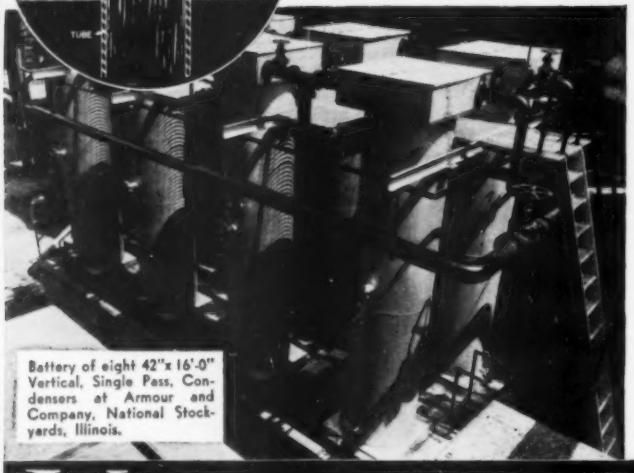


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

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INCORPORATED
1900 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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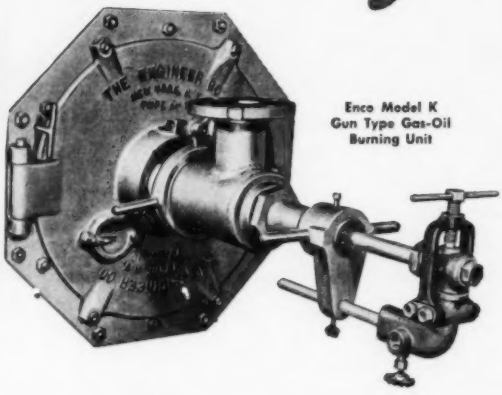
is
COCHRANE's
Major Business

COCHRANE CORPORATION
89
YEARS OF
SERVICE
1863 - 1952

PIONEERS AND LEADERS IN BOILER FEED PROCESS & INDUSTRIAL WATER CONDITIONING

flexible... 3 ways

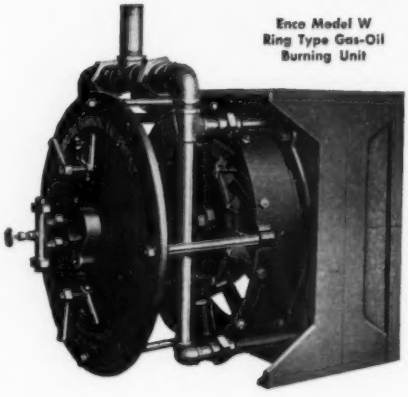
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.

Enco Standard Range Mechanical Atomizer Gun

Enco Wide Range Steam Atomizer Gun

Enco Wide Range Mechanical Atomizer Gun

Enco Standard Atomizer Gun Support

Enco Gas Burning Gun

EC-483A

THE ENGINEER COMPANY
75 WEST STREET, NEW YORK 6, N. Y.

Good Engineering Counts

—ESPECIALLY WITH 3500 HP AT STAKE

THESE 3500-HP, 3582-RPM MOTORS are driving boiler-feed pumps in a midwestern power plant. They were purchased only after a thorough check of Allis-Chalmers two-pole cage motor design details. And their operating reliability has proved that A-C engineering can meet the requirements of the largest boiler-feed pump drives in the power industry. A-3806

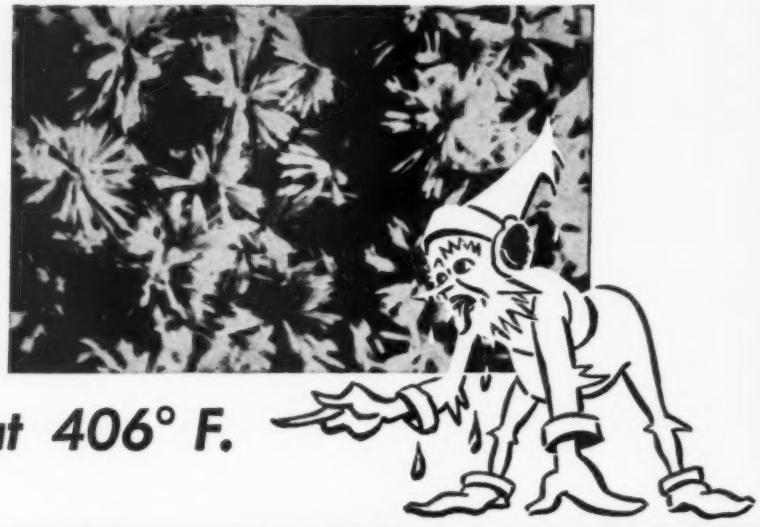
GET THE INSIDE STORY — For more information about large two-pole motors, ask your A-C representative for Bulletin 05B7550. Smaller cage motors are described in Bulletin 51B7693. Allis-Chalmers, Milwaukee 1, Wis.

Here are Some of the Features

- Separate steel balancing rings to provide dynamic balancing without weakening the end rings.
- *Dew-drop* bars that give better performance and stay tight in the rotor core slots.
- Forged end rings, drilled to receive the cage bars.
- Oxygen-free copper or deoxidized copper-base alloy bars and end rings to prevent embrittlement from silver-brazing.
- Air distribution arrangement that eliminates hot spots in both the stator and the rotor.
- Ring-oiling adequate for prolonged emergency operation without forced-feed oiling.
- Equalizing air pressure chambers in the bearing housings to positively keep oil out of the motor windings.

ALLIS-CHALMERS A-C ALLIS CHALMERS

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

DO YOU RECEIVE "Nalco ABSTRACTS"?

"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

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Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card at bottom of page, detach and mail

INSTRUMENTS AND CONTROLS

101 Central Control Panel Systems — Eight-pp Bulletin F 5265 outlines a technique for use in designing economical automatic electric control installations for heating and air conditioning systems. Illustrated by photos and wiring diagrams, it stresses the simplified installation possible, lower over-all costs, increased system flexibility and other advantages of this technique. Barber-Colman Co.

102 Pilots and Controllers — Catalog Section 110, recently revised, shows complete lines of time cycle controllers, pressure controllers, manual remote controllers, vacuum pilots and safety shut-off pilots, and is generously illustrated. The new pressure controller, Type 1400-LP, featured, was designed to obtain smooth control by using bellows for low pressures and to provide a control with a rate of change that can be measured in inches of water. Black, Sivalls & Bryson, Inc.

103 Wide-Angle Smoke Indicators — Bulletin 5101 describes company's Wyd-Angle Smoke Periscope with 90 deg vision angle and the Cat's Eye furnace indicator. Fully illustrated, shows how these instruments are designed and tells where they're best used. Ess Specialty Corp.

104 Electrical Equipment for Cranes — A complete line of electrical equipment designed exclusively for crane service is presented in 32-pp Bulletin C5-1. Covers everything from company's a-c Magnetorque crane control to current collectors, and is generously illustrated with photos, charts and drawings. Includes full data on motors, brakes, controllers. Overhead Crane Div., Harnischfeger Corp.

105 Supervisory Instruments — Catalog 90-2, "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. The measurement of temperature, pressure, flow, power generation and other variables encountered are discussed in this comprehensive booklet. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

ELECTRICAL

106 Resistors for Every Use — Comprehensive 64-pp Catalog 15 illustrates and describes company's line of Vitrohm power-type wire-wound resistors. Lists seven stock types and a variety of made-to-order types. Resistor ratings range from 5 to 550 w, while resistance values listed are from 0.04 ohm to 1.75 megohms. Full details on terminals, mountings and enclosures are given. Valuable selection and application data, charts and tables included. Ward Leonard Electric Co.

107 Float Battery Instruction Sheet — Designed to help power engineers responsible for alarm systems and other systems using storage batteries on float, this sheet shows how and why Plante and Flote batteries are designed to give longer life in floating service. Describes the self-discharge of these batteries that float on lines from d-c generators or rectifiers to supply peak power and take the full load during power failures. Gould-National Batteries, Inc.

108 Differential-Voltage Indicator — Engineering data on an instrument for indication of differential voltage, amperage, speed, pressure or other quantities which can be converted to voltage is provided in Bulletin GEC-892. Discusses stability, simple adjustment, other features; tells how indicator is designed, how it works and where it can be used. Also gives specifications, ordering directions and prices. General Electric Co.

109 Selenium Rectifiers — Recently published catalog sheets provide up-to-date information on selenium rectifiers for anodyzing, electroplating applications, for power conversion for applications involving corrosive atmospheres as well as automatic chargers for industrial truck batteries. Fully illustrated, these sheets explain design features, principle of operation. Wesley Block and Co.

110 Electrical Insulating Tape — A self-bonding electrical insulating tape, Bi-Seal, is described in this bulletin. Explains advantages of this plastic tape for wire and cable splicing. Illustrates drop-wire and bridle-wire splicing with this tape; also provides specifications, physical and chemical properties. Bishop Mfg. Corp.

The mailing card below needs no postage. Two more cards are provided on page 117

111 Improved Insulating Tape — Data Sheet G-25, 4 pp, gives information on modified Silastic R tape, discussing its applications as Class H insulation. Includes physical and electrical properties, also a vulcanising and curing schedule. Dow Corning Corp.

Distribution Apparatus Digest — Catalog 50-000 is company's 100-pp 1952 edition presenting complete data on distribution and dry type transformers, feeder-voltage regulators, instrument transformers, meters, capacitors, circuit breakers, disconnect switches, power fuses and other equipment. Preceding the catalog section are conversion tables and formulas, approximate discounts and a discussion of standardised substations. For a copy of catalog, contact company's local representative — it is not available through this magazine. Westinghouse Electric Corp.

MAINTENANCE COATINGS

112 Anti-Rust for Over Rust — Data File 2158A, 4 pp, describes Overust anti-rust paints, giving their chemical properties. Explains how these paints contain chromates which make them effective against rust even when applied directly over rusty surfaces. These paints come in five colors and clear and are for use over any kind of metal surface. Bulletin gives coverage, complete application data. The Chem Industrial Co.

113 Corrosion Resistant Coating — Form S-5251 is on Ricwilite 7100, a cold-setting phenolic resin. This coating is said to form a tough, flexible adhesive film which is tasteless, odorless and non-contaminating; it is suggested for use where baked-on coatings are impractical. Some of these uses are discussed in the bulletin which gives physical properties, resistance to common chemicals and solvents, and application procedure. Ric-Wil Plastic Coating & Mfg. Corp.

MECHANICAL POWER TRANSMISSION

114 Roller Chain Data Book — Book 2457, 148-pp, is one of the most comprehensive on roller chain and its application. Detailed engineering information covers the selection, installation, lubrication and maintenance of roller chain for drives and conveyors, and sprocket wheels. Shows photos and line drawings of the many types and sizes of chain and wheels, also 59 typical conveyor chain attachments. Design notes and selection

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data serve as a practical text on the use of roller chain; formulas, charts, diagrams and typical problems simplify selection. There's also a section on pre-selected drives available from stock, as well as a guide to the use of stainless steel and bronze chains and a table listing resistance to 400 corrosive reagents. Link-Belt Co.

115 **Variable Speed Drives** — Company's Allspeed motor drives of ¼ to 7½ hp are described in 16-pp Bulletin AS-1600-B6. Presents both horizontal and upright drives of closed or skeleton types. Pictures ease of belt change, discusses service, electric motors, torque, bases, adverse operating conditions, shaft variations and mounting. Provides selection data, tips on operation and maintenance; explains features and advantages of these drives. Worthington Corp.

116 **Centrifugal Refrigeration Drives** — E-M Synchroniser No. 36, 24 pp, deals with the application of a-c motors to centrifugal refrigeration compressors. Includes article covering refrigerant charcteristics, compressor capacity control, motor characteristics and control. Also includes articles on "The Line Diagram," and "How to Select Control for Wound Rotor Motors," and charts and tables of engineering information. Electric Machinery Mfg. Co.

117 **Bearings and Bars** — Brand new Catalog 52, 74 pp, presents up-to-date information on a line of standard stock bearings, precision bronze bars, electric motor bearings and graphited oilless bearings. Fully illustrated, indexed, provides sizes, ordering information, design and engineering details; also discussion of operating principles of the sleeve bearing, grooved bearings, installation of bearings, and special bearings. Lists 854 sizes of standard stock bearings. The Bunting Brass & Bronze Co.

118 **Flexible Coupling** — Bulletin 2200 gives complete data on company's crown coupling, including construction details, ratings, speeds, applications and selection tips. DeLaval Steam Turbine Co

119 **Facts on Belt Dressings** — The special advantages on this manufacturer's transmission belt preservative are stressed in illustrated Bulletin 526. Photos show it permits belts to be operated "slack" for lower power consumption, longer belt life. Includes check list of factors important in the choice of a preservative. Cling-Surface Co.

VALVES, TRAPS AND PIPING ACCESSORIES

120 **Air Relief Traps** — Illustrated Bulletin 2062 gives data on types and installation methods for ball float traps designed to vent air from any liquid under pressure. Pictures some typical uses for the traps, names other applications. Armstrong Machine Works.

121 **Diaphragm Motor Valves** — A double-seated diaphragm valve is described and illustrated in 8-pp Specification Sheet 400-4. This is a wide band proportional control valve. Pertinent data on it — sizes, construction and trim materials, temperature and pressure ratings for various body materials, pressure drops, and mounting dimensions — are given. Also described are types of discs available, design advantages. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

122 **Diaphragm Valves** — Recently revised Catalog Section 105 offers the latest data on manufacturer's diaphragm control valves. Provides photos, sectional drawings and face-to-face dimensions of the new or completely redesigned items. New valves shown include the Type 87, with bellows sealed stem, for use where even slight leakage of flowing medium might become obnoxious, dangerous or expensive, and an expanded outlet valve designed to control flow of gases that require increased volume on release of pressure, or liquids subject to flashing. Black, Sivalls & Bryson, Inc.

123 **Refrigerant Purger** — This bulletin describes a forged steel purger for venting air and other non-condensable gases from refrigerating systems. Discusses air problem, explaining how purger operates, and giving physical data, price. Purger is for use with common refrigerants. Armstrong Machine Works.

WATER CONDITIONING

124 **For Scale and Corrosion Control** — Eleven of company's organic glucoside derivatives are described as to general properties and specific applications in this new bulletin. The various glucosates are now sold in drums ready for use. D. W. Haering & Co., Inc.

125 **Pressure Filter for Water** — Both vertical and horizontal types of company's pressure filter for removal of visible suspended matter from water are discussed in the 12-pp bulletin, WC-107. Details of design and construction of these units, plus their accessory equipment, are furnished. Valve and piping arrangements are fully treated, along with complete tables of capacities, dimensions and weights. Graver Water Conditioning Co.

HEAT EXCHANGERS, HEATERS

126 **Finned Tube Heat Exchanger** — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Specifications and dimensions are included. Many illustrations show representative illustrations along with reports of service records. Griscom-Russell Co.

127 **Instantaneous Heaters** — Besides explaining construction features which contribute to the efficiency of manufacturer's instantaneous heaters (two-, four- and six-pass hot water units) and how to select them, Bulletin 35-78 devotes 49 of its 56 pp to tabular material on capacities and pressure drops for 198 heaters. These cover 12 temperature ranges and nine steam pressures from 0 to 100 lb. Provides an exploded view of a heater, complete dimension-weight-price table. Includes illustrations and descriptive material on other heaters and coolers. American District Steam Co., Inc.

PACKINGS

128 **Braided Rod Packing** — This 8-pp bulletin outlines advantages of company's lattice-braid rod packing. Contains sectional drawings, showing their unique structure, illustrations of types available, tables of service recommendations, specifications and reports from users. The Garlock Packing Co.

129 **Packaged Packing** — Illustrated Bulletin 443 presents the "Handy-Pack" package consisting of a convenient combination of metallic and plastic spiral packings for general sealing applications. Recommends this package for its value around the plant in providing flexible, lubricated metallic and semi-metallic spirals for cutting into average stuffing box requirements. Durametallic Corp.

COOLING

130 **Cooling Towers** — Bulletin CT-24-4 is a generously illustrated 36-pp booklet on mechanical induced-draft counter-flow cooling towers. Stresses advantages of this type of tower, describes and pictures design and construction, choice of casings available. Distribution system, and major equipment are described in detail and effects of recirculation and surroundings on cooling tower performance covered. Foster Wheeler Corp.

131 **Spray Nozzles** — Power engineers interested in spray nozzles for cooling ponds, cooling towers and similar heat transfer applications will find a wealth of information in 40-pp Bulletin 5200. Describes industrial spray nozzles for a broad range of commercial and industrial processes. Data given include dimensions, capacities, spray angles. All nozzles are illustrated, cutaway drawings

(*Continued on page 117*)

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Maintains low neutralization number. Lasts indefinitely. Prevents rust on all oil-bathed surfaces.

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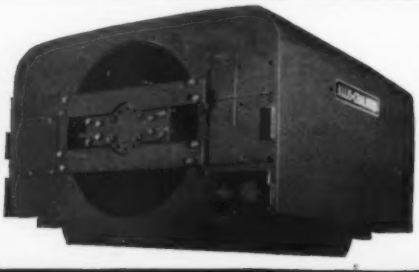
STEAM TURBINE GENERATOR UNIT

Doing Double

AT ONE OF WORLD'S LARGEST MALT



SIMPLIFYING INSTALLATION, both turbine and generator (shown at left) are shipped as complete assemblies with the rotors locked in place. The WA-Series generator is of the housing type with air-coolers mounted in the stator above the floor lines, eliminating special coolers and duct work.

Ladish Malting Co. Uses Steam for both Processing and Power Generation

Duty

HOUSES!

GREAT QUANTITIES OF STEAM are required in the process of manufacturing 10 million bushels of malt annually at the Ladish Malting Co., Jefferson Junction, Wisconsin. And, as an economic by-product, the electric power needed for plant operation is generated by the same steam.

When this world's largest single unit malt house recently needed more generating capacity, Allis-Chalmers again was chosen. And with good reason, since two Allis-Chalmers units had been supplying the electric power consumed at the Ladish Malting Company for nearly fifteen years.

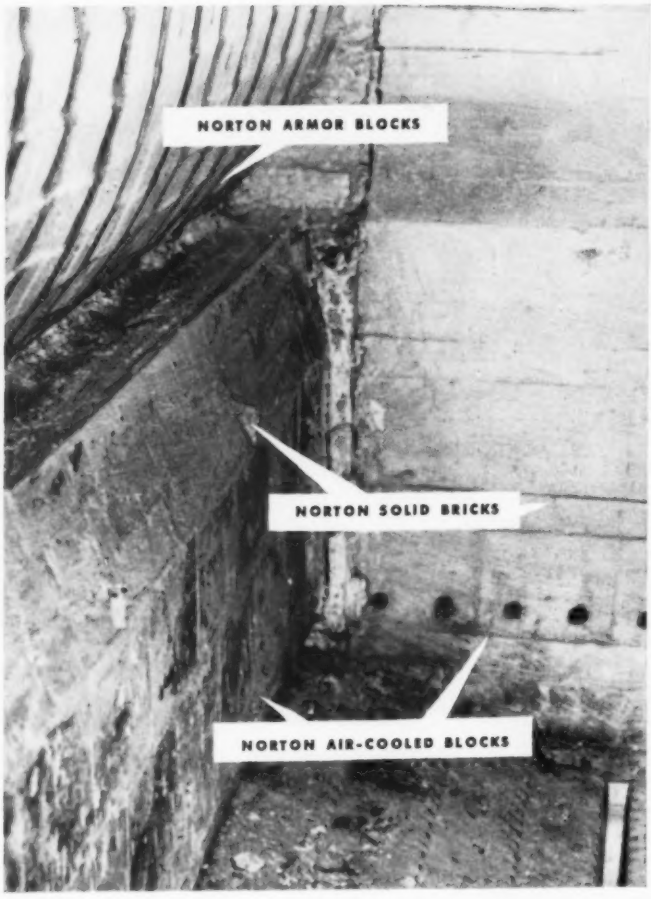
Installed in 1951, the modern 2500 kw WA-Series unit shown here is now on 24 hr a day, 7 day a week duty. It consists of a non-condensing impulse steam turbine and housing type air-cooled generator and exciter . . . carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA ratings through 7500 kw, a modern WA-Series unit also will enable *your* power plant to meet tomorrow's expanded power demand. Complete details contained in new Bulletin 03B7654. For your copy, just call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3401

ALLIS-CHALMERS

A-C ALLIS-CHALMERS



Inside story of longer boiler life

...and fewer shut downs

The inside story of more production and less maintenance in any type of boiler can be said in one word, "Norton."

Whether your problem is air-cooled walls, solid walls, or boiler tube protection Norton CRYSTOLON* Refractories will solve it most economically.

Use Norton CRYSTOLON Refractories for Complete Boiler Wall Protection for these four reasons:

1. They stand up under high heat (up to 3050F).
2. They are virtually impervious to slag penetration.
3. They are practically clinker-proof.
4. They stand up under abrasion caused by the moving firebed of stoker fired furnaces.

Installation is easy and inexpensive. Armor blocks can be laid dry from the fire side. They're tapered for secure locking around the tubes. Air-cooled blocks and companion bricks have mating tongues and grooves to simplify wall construction.

For laying up bricks, ALUNDUM* Cement is recommended. For air-cooled wall construction a CRYSTOLON Cement, which matures at a lower temperature, proves better.

You'll get more power per boiler for more years at lower cost with Norton CRYSTOLON Refractories and Refractory Cements.

Write for Bulletin

For more information about the installation of CRYSTOLON shapes and ALUNDUM Cement write for Bulletin 862, Norton Company, 623 New Bond Street, Worcester 6, Mass. Canadian representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

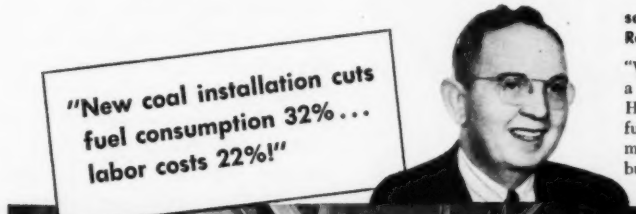
NORTON

Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

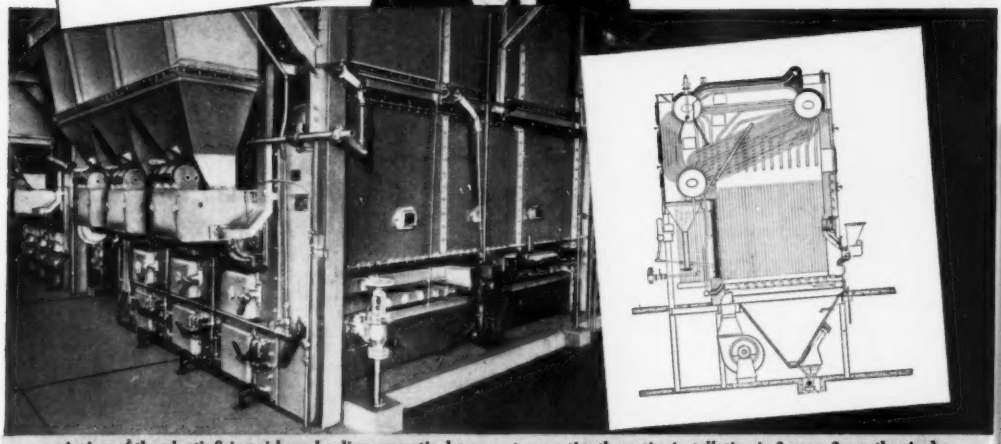
"WE SAVE OVER $68,000 A YEAR— BY BURNING COAL THE MODERN WAY!"



"New coal installation cuts fuel consumption 32%... labor costs 22%!"

says Mr. H. A. Sherer, Chief Engineer, Reeves Steel & Manufacturing Co., Dover, Ohio.

"We installed two new boilers and stokers and a modern coal- and ash-handling system. Here are our yearly savings: $38,576 saved on fuel, $9,353 on labor, $20,739 on repairs and maintenance. That's a total of $68,668—saved by burning *bituminous* coal the modern way!"



A view of the plant's firing aisle and a diagrammatic drawing of one of the boilers. It now costs 18.8¢ less to generate every thousand lbs. of steam. This is a saving large enough to amortize the entire installation in 3 years-3 months. And that includes all the cost incurred in tearing out old equipment and constructing a new plant floor!

• Today, *bituminous* coal's inherent economy has been greatly increased. Modern combustion installations give you more steam for every dollar . . . automatic coal- and ash-handling systems cut labor costs to a minimum.

A consulting engineer can show you how coal can do a better job—*and save you real money*—in a plant designed to meet your *specific* needs.

In addition, with coal you get the basic advantages of price stability, and dependable supply. These advantages are assured by America's virtually inexhaustible coal reserves and the high productivity of America's coal industry.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

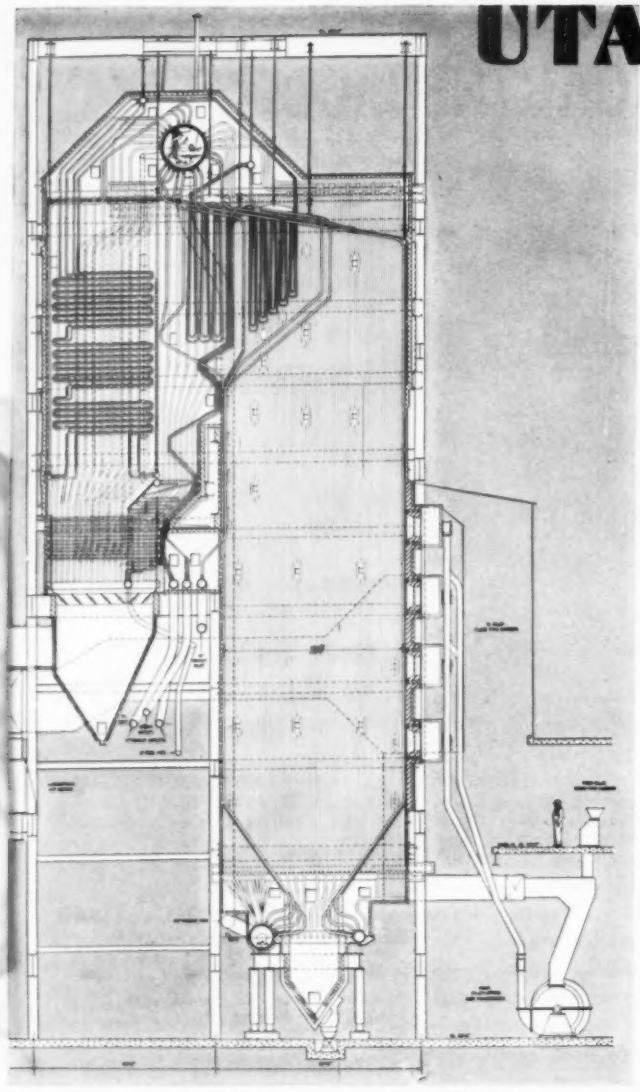
BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

UTAH Goes to



Utah Power & Light Co., Salt Lake City, Utah
575,000 lbs./hr. — 1700 psig, 1000°F. — 525,000 lbs./hr. reheat — 396 psig, 1000°F.
Bechtel Corp., Engineers.

Utah Power and Light Company is installing a 575,000 lbs. per hour 1700 psig 1000°F. Riley unit with 525,000 lbs. per hour reheat at 396 psig and 1000°F. at its Gadsby station at Salt Lake City as unit No. 2. Some of the outstanding features of this unit are mentioned on the following page. Unit No. 1 now in operation is a 620,000 lbs. per hour 1500 psig, 955°F. Riley unit. Unit No. 2 is to be fired with Riley "50" Pulverizers. Unit No. 1 is fired with petroleum pitch but designed for future pulverized coal firing.

At its Hale Station, Utah Power has installed a 450,000 lbs. per hour Riley pulverized coal fired unit and another Riley unit is installed at its subsidiary Western Colorado Power Co., Jim Bullock Plant at Montrose, Colorado.

Engineering Data

Capacity, 575,000 lbs./hr.
Design Pressure, 1,700 psig.
Steam Temperature, 1,000°F.
Reheat Temperature, 1,000°F.
Furnace Volume, 53,000 cu. ft.
Temp. Furnace Exit Gas, 1,900°F.
Furnace Width, 29'3"
Furnace Depth, 23'10⅞"
Efficiency, 87.8%
Fired by 4 Riley "50" Pulverizers and 12 Riley Flare Type Burners

TRADE MARK Rx REGISTERED

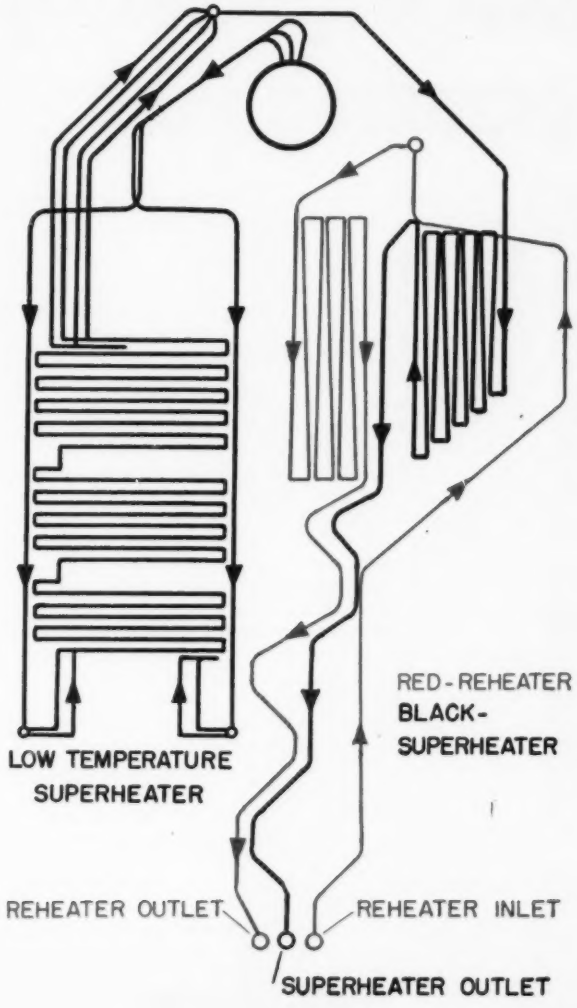
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston Cincinnati New York Charlotte Philadelphia Atlanta Denver Washington New Orleans Salt Lake City Buffalo St. Louis Los Angeles Pittsburgh Kansas City Portland Cleveland St. Paul Seattle Detroit Tulsa Chicago Houston

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

1700 psig 1000°F and 1000°F Reheat



Reheater Partially Radiant

Due to the large amounts of heat required to give 1000°F. steam temperatures for both superheater and reheater, design features must be incorporated which will give the desired steam temperatures and at the same time permit operation at sufficiently low furnace temperatures to prevent objectionable slagging of furnace and screen tubes.

Riley accomplishes this by making the first section of the reheater of radiant surface as illustrated in the accompanying diagram. With the relatively low reheater inlet temperature and high positive flow velocities the use of radiant surface is definitely warranted. By this design the desired steam temperatures are obtained with entering gas temperatures well below the danger point.

Uniform superheat temperatures over a wide load range are obtained by means of by-pass dampers beyond the economizer. A spray type temperature control is provided for the reheater. The use of four rows of burners also aids in controlling steam temperatures.

All tubes entering the upper and lower drums are welded to stub ends, shop welded into the drum shells. All superheater and economizer tubes are likewise welded to stubs ends welded to the headers. Such construction assures permanent tight connections.

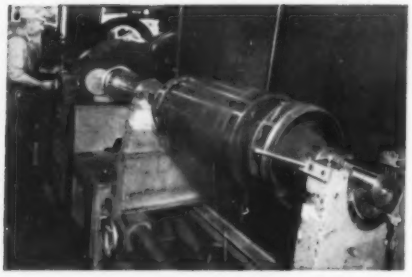
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

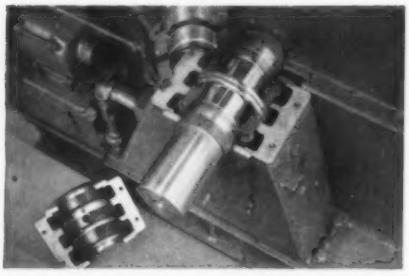
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

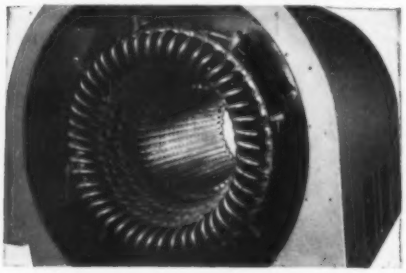
New big motor engineering for big pumping jobs



PRECISION ROTOR BALANCING in dynetric electronic balancing machine. Heating and overspeed runs season the rotor before balancing, to insure retention of balance. Interference fit between rotor core laminations and rotor spider prevents any shifting in service.



FORCED-FEED BEARING LUBRICATION assures a proper supply of cool oil. Double oil rings provide starting and emergency lubrication. Shaft journal is super-finished, and Kolene processed bearings are centrifugally cast . . . important to cool running at high speed.



TURBINE-GENERATOR TYPE END LASHINGS. Each coil is lashed and braced to two lashing rings, and to adjacent coils, with spun glass cord. Coils have mica insulation . . . are vacuum pressure impregnated with insulating varnish and thoroughly baked. Coil exterior is highly resistant to moisture.

Pumps are getting bigger.

Motor drive reliability thus becomes more and more important. And the only sound way to get maximum drive reliability is to rely on specialized big motor engineering . . . which means "extra-value" engineering of every motor part to meet the most exacting needs of its specific job.

Two recent examples of this "extra-value" engineering are the big, high-speed E-M Induction Motors shown here. The frames for these motors are "turbine generator" type, extra heavily built for strength and stiffness. The rotor shaft is extra big and strong, and the cage winding is solidly anchored with tough alloy steel. The precision balance is made to better than commercial standards, which contributes to smooth, quiet operation.

Distortion of the coils under full-voltage starting is prevented by lashing the coil-ends tightly to two high-strength insulating lashing rings. Heavy non-magnetic arms hold the rings firmly in place and minimize stray load losses. Three more examples of "extra-value" engineering are shown at the left.

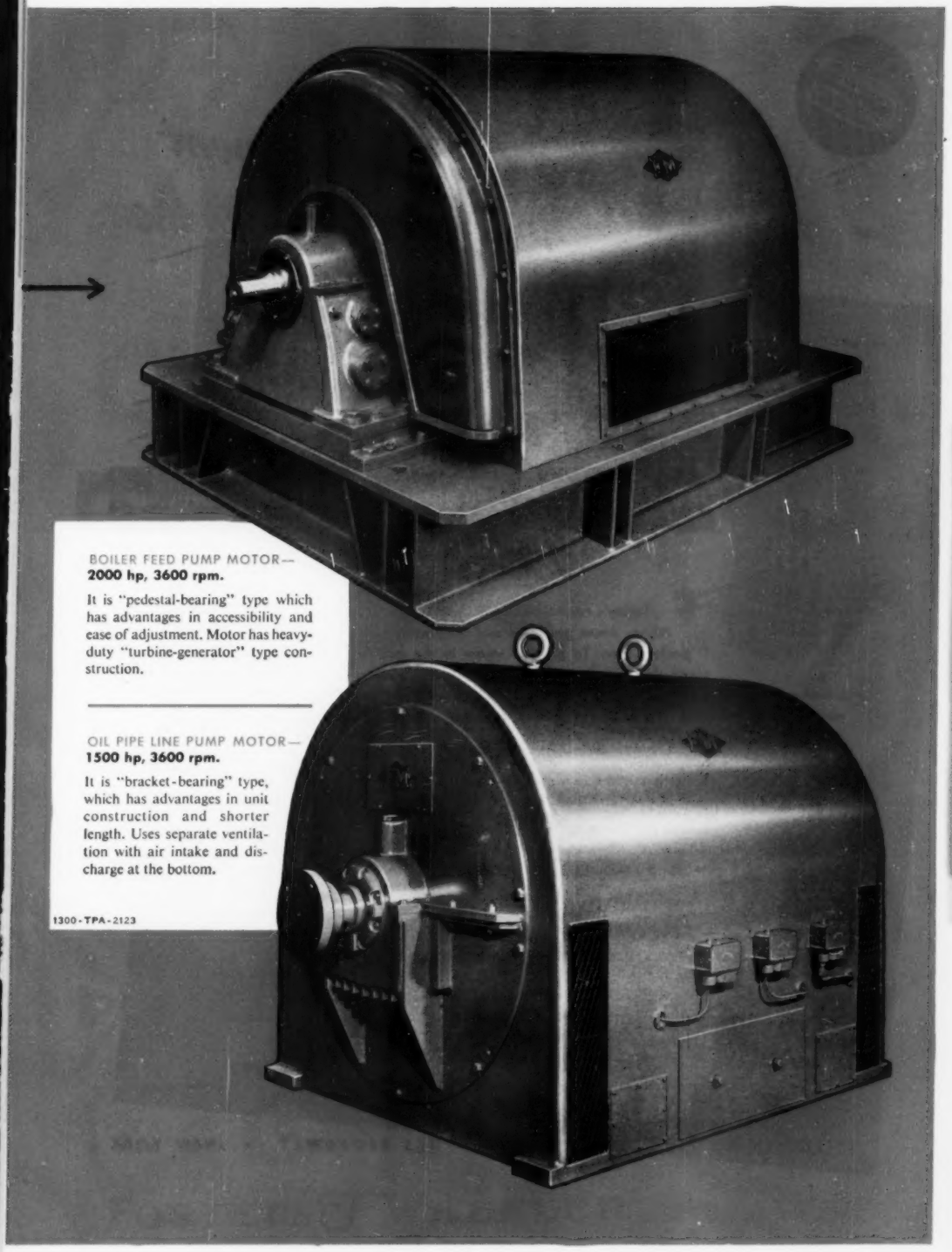
To get these "extra-value" engineering features for reliability of your big drives, it will pay you to investigate E-M Motors. Call in the E-M man near you. He is an experienced, competent, big motor application engineer.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

E-M

Specialists in

Big Motor Engineering



BOILER FEED PUMP MOTOR—
2000 hp, 3600 rpm.

It is "pedestal-bearing" type which has advantages in accessibility and ease of adjustment. Motor has heavy-duty "turbine-generator" type construction.

OIL PIPE LINE PUMP MOTOR—
1500 hp, 3600 rpm.

It is "bracket-bearing" type, which has advantages in unit construction and shorter length. Uses separate ventilation with air intake and discharge at the bottom.

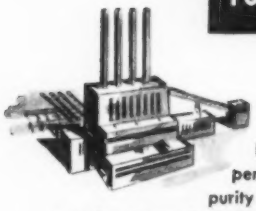
1300-TPA-2123

From the pioneering development in Superheaters to the

the trend in modern steam generator design

places the spotlight on . . .

FOSTER WHEELER combination radiant and convection



Today's central station calls for larger unit sizes of turbines and boilers—higher steam pressures and temperatures—and optimum quality and performance. To provide steam in the quantity, pressure, temperature and purity demanded, increased emphasis falls upon the design and function of superheaters and reheaters. Their integration with other components of equipment and plant requires the high degree of skill and experience that comes only with years of leadership in the field.

Foster Wheeler's pioneering effort in steam generator design, as reflected in the following record of achievement, has led the way for every major development in the reheat cycle.

1902 — Superheated steam introduced commercially in the United States.
1904 — Convection superheaters standardized with cast iron extended surface rings applied to steel tubes. Bare tubes were later used with improved design technique and improved metal selection.
1919 — Radiant superheaters developed after long research and experimentation.
1924 — Water walls and water backs applied to many types of furnaces burning various fuels.
1926 — Radiant reheaters and radiant superheaters installed in one of the first large high pressure reheat units in the country.
1946 — First large steam generator installed in a central station to operate over a wide load range at 1000 F final steam temperature.

As a result of this 50 years' background of experience and leadership, each new steam generator can be depended upon to have Foster Wheeler's integrated quality and performance.

FOSTER WHEELER CORPORATION • 165 BROADWAY • NEW YORK

complete reheat cycle

superheaters and convection reheaters
One million lb steam per hr 1525 psig 1005 F/1005 F is the rated capacity of this unit now under construction for a large eastern central station.

6, NEW YORK

FOSTER WHEELER

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 36 and 117 for your request. Just list the numbers of the items you'd like to know more about

1—NEOPRENE LIQUID

Protective coating, is available in three new types

Mercer-Proco, a neoprene coating which can be sprayed, brushed, rolled or trowelled to provide a uniform sheet of Neoprene, is now offered in three new types. One of these, N-700 is an air-drying maintenance coating for protection against high temperature, steam, acid fumes and splashes, solvents and general wear. It is oil- and grease-resistant, resilient and non-porous, company says, and can be used on metal, concrete, wood, beams, machinery, floors, tank exteriors. It dries within minutes, needs no elaborate surface preparation, and comes in three colors.

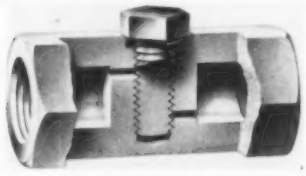
Type N-600 is acclaimed for its skid-proof qualities and suggested for use where protection against skidding is essential, such as floors, ramps, steps, metal, concrete and wood. It is reported to have an extra long service life. It air dries overnight, comes in three colors.

Designed primarily for equipment protection, N-200 is suggested for heavy immersion service on valves, pumps, pipes, impellers, tanks for acids etc. It may be applied to metal, wood or concrete. Type N-200 is known for its chemical stability and resistance to most acids. It air vulcanizes in 5 or 6 days, but if used on surfaces subject only to splashing requires only 24 hr of drying. Literature is offered on all three types of this coating. Mercer Rubber Corp.

2—AIR FLOW SNUBBER

And pulsation dampener has many instrument applications

This unit is designed to provide a controlled slow rate of flow of compressed air or gas for operation of continuous-reading hydrostatic instruments and for purging pneumatic instrument lines. It also protects pneumatic testing and gaging equipment against damage that might result from surge pressures by



providing a flow restriction in the line. The snubber also is used as a pulsation damper for pressure gages, recorders and manometers. Placed in the line between the instrument and the pressure source, it damps or "smooths out" pulsations so the instrument gives a steady reading.

Snubbing action is accomplished by passing air or gas through a helical restricting passage around the threads of a screw at right angles to the snubber body. The snubber is made of hexagonal brass rod except for a neoprene O-ring which seals the scrubbing screw. Inlet and outlet are tapped for ¼ in. pipe. Flow rate is 0.04 cfm at a pressure drop of 70 psi. Maximum operating pressure is 1000 psi. Full details are given in Bulletin 317. King Engineering Corp.

3—PLASTIC PIPE

For enclosing, protecting all types of electrical wiring

This lightweight pipe is an excellent insulator, says manufacturer; it can be installed quickly and economically and afford protection for many years. Because the pipe is flexible it can be curved to follow surface contours as well as structural plans. It is supplied in lengths up to 400 ft and requires few fittings, necessary connections being made with molded plastic fittings. Resistance to chemical action of corrosive waters and soils makes the new pipe especially advantageous for underground and underwater installations, company points out. Carlon Products Corp.

4—PISTON SEAL

One piece, molded elastic, for all pressures and strokes

The HydroSeal is designed as an alternate for diaphragm or piston operated devices and can be incorporated in the design of pneumatic and hydraulic motors, glands, shaft seals, cylinders, pumps, brake mechanisms, other devices. It is being manufactured in natural rubber, Buna-N, Butyl and other synthetics to meet special applications.

Similar to conventional diaphragm construction, the HydroSeal also incorporates a circumferential holding method which utilizes a peripheral bead for pressure tightness. Company explains that since HydroSeal is substantially a cylindrical form of rubber it will stretch, rather than flex, within safe limits of the materials being used. In this stretching or elastic motion the stroke required is readily designed into the HydroSeal. And since it is supported by metallic backing, i.e. the piston or ram, there is said to be no tendency for this seal to rupture. The Farris HydroSeal Corp.

5—AIR DIFFUSER

Automatically adjustable, controls temperature, humidity

The Flexiflo Air Diffuser, Type A, is designed to permit considerable variation in the quantity of air delivered without materially changing the radius of diffusion. It has an air cylinder attached directly to the shaft controlling the movement of the blades. With this cylinder hooked up to an air cylinder operating through a humidistat, automatic control is achieved.

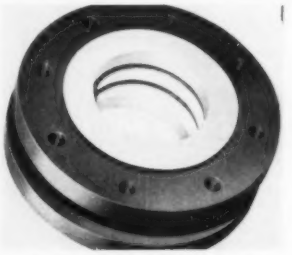
By using a humidistat in series with a thermostat the volume of air could be reduced when the thermostat is satisfied but the humidistat is not. When the humidity becomes too high the effective area of the Flexiflo will be reduced, thus cutting down the volume of air handled and at the same time reducing the outlet temperature of air leaving the coil.

This diffuser is also suggested for maintaining constant temperatures through volume control at source of supply, especially in large areas where the load is subject to sudden changes. Universal Diffuser Corp.

6—FLEXIBLE COUPLING

Features a new adaptation of the Teflon bellows

The Chemiseal Flexible Coupling is composed of a bellows with only two convolutions, assembled with flanges of either cast iron, aluminum or special metals, and embodying integral gaskets. These couplings are suitable for connection to any of the major manufacturers' flanged-end designs of piping. Besides joining piping of equal material, they are suggested for joining Pyrex piping to glass-



lined steel, and glass-lined steel tube to Karbate, Haveg and steel pipe. These couplings also make adapters unnecessary, eliminating need for slip joints and taking the place of gaskets at the point of use.

Among features announced for the couplings are ability to absorb vibrations between pumps and piping, to compensate for slight misalignments of piping and equipment outlets and to accommodate slight movement of piping when connected to weighing devices. The couplings are said to be impervious to all chemicals except molten sodium and fluorine. United States Gasket Co.

7—ASPHALT FABRICS

Cotton, glass or jute, for reinforcing in roof repair jobs

These asphalt-saturated or tar-saturated fabrics are available for use in patching roofs, repairing skylights, flashings, parapet walls and soil pipes. They serve to prevent recurrences of leaks in the same spots where they occurred before recoating. The fabrics come in five widths from 3 to 36 in., in 150 ft rolls. Byerlyte Corp.

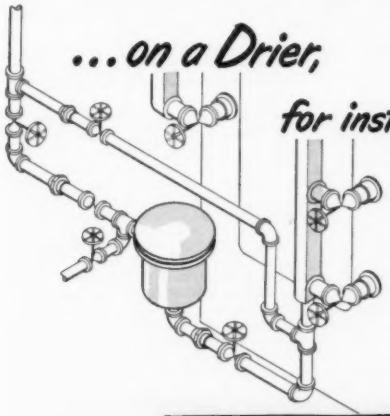
8—FLOW METERS

Open channel, available in mechanical or electric types

The new Series 500 Open Channel Flow Meters for measuring, recording and controlling the flow of water, sewage, industrial plant effluent and other liquids, supersede company's Model 40M line. The flow is determined by measuring the head of liquid flowing through a flume or over a weir in the flow channel. This measurement of head is interpreted by a cam cut to the equation of the weir

Example of Steam Trap Durability

...on a Drier, for instance



THE INSTALLATION

On heavy-duty, steam-heated tumbler-type drier at American Linen Supply Company, Cincinnati.

THE HISTORY

A high discharge capacity trap was needed to operate this drier 16 hours daily under heavy loads, with 125 psi. steam. Specifications called for rapid, fully automatic condensate removal to insure fast warm-ups and a steady flow of hot, dry steam to the drier. Naturally, the lowest possible trap maintenance cost was also wanted.

The choice was a Crane 150-Pound Inverted Open Float Steam Trap, carefully selected for adequate drainage capacity, and above all, properly installed.

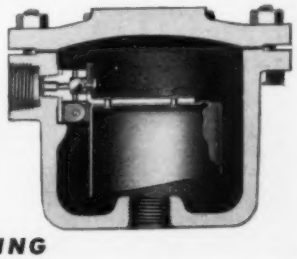
In service more than 8 years and never needing any repairs or new parts, the Crane trap has given complete satisfaction. Total maintenance expense: periodic routine inspection only.

TRAP SERVICE RATINGS

SERVICE LIFE:	More than 8 years - Heavy duty
SUITABILITY:	High discharge capacity
MAINTENANCE COST:	None - Routine inspection only
SPECIAL FEATURES:	Simple, dependable mechanism
OPERATING RESULTS:	Fast warm-ups - Steady, even heat
PRICE:	Good Buy
AVAILABILITY:	Stock item in Crane line

THE TRAP

Crane Iron Body Inverted Open Float Steam Trap, for 1 to 300 pounds saturated steam working pressures. Small and compact in all sizes, yet has high discharge capacity. Patented ball-type seating gives positive pressure seal. Simple operating mechanism with only one moving unit assures durable, trouble-free performance. See your Crane Catalog or your Crane Representative for complete data on these highly efficient traps.



The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

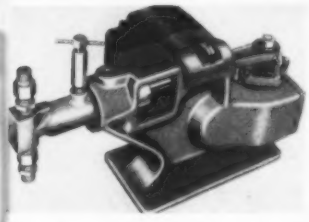
or flume, into terms of flow, which is recorded on a uniform chart and integrated if desired.

In the mechanical type of meter the cam mechanically moves the pen arm across the chart. The electric type uses company's timed-impulse type of remote recording. With this type, the record can be made at any distance from the point of measurement. The Bristol Co.

9—METERING PUMP

Is self-contained unit for feeding chemical solutions

The Model X-52 Adjust-O-Feeder is designed to provide accurate feeding of chemical solutions for plants where low capacity and medium pressure will meet requirements. The unit is described as compact and inexpensive; it has built-in oil-enclosed gear reduction and built-in standard motor. Since the crank and connecting rod operate in a horizontal



plane, the scale for the micro-stroke adjustment is convenient to read. The Model X-52 has a one-piece Meehanite iron frame, weighs less than 100 lb and is ready for wiring and piping connections. The standard unit has an adjustable capacity range of 1 to 10 gph discharging against pressures to 650 psig, but a feeding range of 0.5 to 5 gph is also available. Further information on this new pump is provided in Bulletin 1105. % Proportioneers, Inc. %

10—PACKAGED BOILER

Is designed for efficiency and economical operation; in 16 sizes

The horizontal fire-tube boiler is the basic component of the Powermaster, an automatic packaged steam generator of three-pass internal furnace construction. Combustion gases travel through the central combustion tube, reversing their flow back through the lower bank of tubes, then again toward the rear branching through two lateral banks of tubes. Burners for light oil, heavy oil and commercial gas fuels as well as dual combination burners modulate between 30 and 100 per cent of full load rating.

Sixteen sizes are available covering 15 to 500 hp for pressures to 250 psi. Specifications on this boiler are given in Bulletin 1218. Orr & Sembower, Inc.

11—SILICONE RESIN

For electrical insulation, has unusual resistance to high temperatures

SR-98, a new silicone resin for Class H electric insulation, is said to maintain its bonding strength and hardness at 50 to 90 C above other commercially available silicone resins. This permits greater design flexibility in motors, transformers and generators where vibration is a factor. Because of its bonding strength and lack of flow at high temperatures, coils and other rigidly mounted components are held more securely in position.

Having solvent and abrasion resistance over a wide temperature range, SR-98 forms a hard, tough insulating film. When used to treat glass cloth, asbestos paper or cloth, and mica products it produces a more rigid type of product, says manufacturer. The new silicone resin is supplied at 50 per cent solids content; it can be thinned with xylene, toluene or petroleum spirits and no catalyst is required. Chemical Div., General Electric Co.

12—LIQUID LEVEL GAGE

For low pressure storage tanks, simplifies level reading

Designated the Figure 2500, this new automatic tank gage, incorporates a full-view direct reading counter in the look box for quick, accurate reading of foot increments and a dial for reading inches and fractions of tank contents. The Neg'ator motor housed with the gage head is designed to maintain a predetermined constant tape tension. This eliminates the need for a conventional counterweight.

Other features of this gage include adaptability to all arrangements and types of low pressure tanks up to 70 ft in height, and the advantage that its look box may be installed at any desired height. The gas-tight look box is also adaptable for installation on existing float operated tank gages using ½ in. wide tape sheaves, company says. The Vapor Recovery Systems Co.

13—TEFLON PACKING

Offers high resiliency, versatility, as well as moderate cost

No. 401 Packing is a braid-over-braid asbestos type impregnated with Teflon throughout. Chief advantage claimed for it is the superior resilience imparted to the Teflon by the integral asbestos fibres. This resiliency permits a tight seal at low gland pressure, company says, and solves the cold flow problem sometimes encountered with solid Teflon packing. Since it is furnished in continuous form, and is highly resilient, one size is suitable for packing a number of different stuffing boxes.

This packing can't be attacked by nor contaminate any industrial acids, alkali or solvent, it is said. It has Teflon's characteristically anti-adhesive surface that promotes free spindle operation, and is serviceable from −100 F to 500 F. It comes in continuous lengths, square cross section, in sizes from ⅛ to 1 in. by 1/16 in. increments. Mechanical Packing Div., Flexrock Co.

Want more details on these new products? Use the post cards on pages 36 and 117

14—SHUT-OFF VALVE

Midget solenoid, incorporates time delay mechanism

The time delay mechanism in this valve acts to hold back the flow of liquid or gas through the valve for approximately 5½ sec after the solenoid becomes energized. This feature makes the valve particularly useful in oil burner applications where it is desirable to have instant combustion, company points out. The time delay mechanism holds back the flow of oil until a full stream of air, sufficient to make a perfect combustible mix is flowing through the burner. On subsequent stoppage and re-lighting, the delay gives time to purge the fire box of old fumes and smoke.

The valve has ⅛-in. pipe connections and 1/16 in. port for pressures to 15 gph flow. A similar valve has ⅛ in. port for pressures to 125 lb, 40 gph, with time delay of 6½ sec. Brass or stainless steel body available, with stainless steel operating parts, soft composition disc. Automatic Switch Co.

15—ROTARY JOINT

Is available in syphon and single-flow types

This new rotary pressure joint is designed to convey liquids and gases from a stationary pipeline to a revolving receptacle. Among the outstanding features announced for it are an external screw adjustment by means of which normal wear of the rotary seal can be compensated for on the spot, in service, without removal of rotary joint, to prevent leakage and reduce maintenance costs. Its floating rotary seal, made of graphite composition, is self-aligning in any direction, axially as well as radially, to avoid possibility of leakage caused by misalignment of rotary shaft. A pressure equalizing chamber relieves the rotary seal of excess pressure.

The joint is furnished in standard Class 15 capacity: 150 psi, 350 rpm, 350 F; sizes from ½ to 1¼ in. IPS. Bulletin 5500 describes it. Seamlex Co., Inc.

16—VARIABLE TRANSFORMER

Is especially designed for low wattage applications

To meet the need for variable a-c voltage control in applications involving 50, 100 and 150 w, the Type 10 Powerstat is offered. It is rated 120 v, 60 cycles, single phase input with an output of 0–120/132 v, 1.25 amp, 150/165 va. It is described as the smallest of variable transformers, both physically and electrically.

The Type 10 Powerstat doesn't waste power in the form of heat, company says, and consequently it is cool in operation. It is designed to supply a continuously adjustable voltage to any load up to its rated capacity. For single hole mounting, it has a projection on the base for keying to the panel, and its compactness permits installation under a 3-in. chassis. The Superior Electric Co.

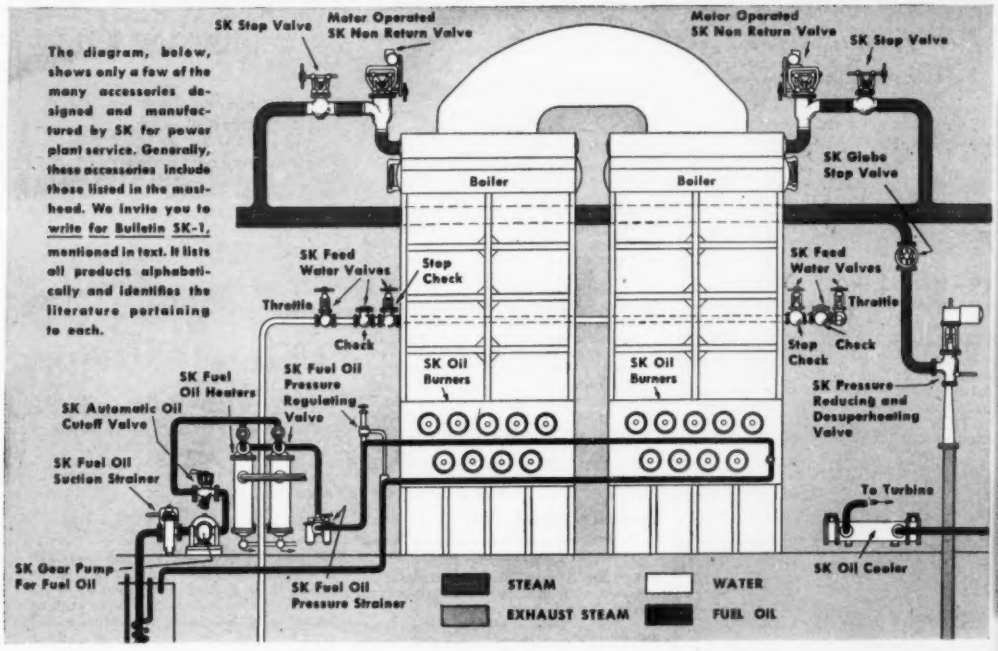
17—NIPPLE CHUCK

Is handy tool capable of threading ⅛- to 2-in. pipe

Described as the last word in simplicity, the new "55" Universal Nipple Chuck has but three parts: polished steel body, sliding plunger and hardened steel threaded shank. Nipples are removable by hand. Adapters allow for all sizes

TRADE PAPER EDITION
Published by
SCHUTTE and KOERTING Company
ENGINEERING News
JET APPARATUS • HEAT TRANSFER EQUIPMENT • ERDUCERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • ROTAMETERS • FLOW INDICATORS • RADIAFIN TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

WANT ENGINEERING ASSISTANCE IN APPLYING HIGH PRESSURE POWER PLANT ACCESSORIES?


The diagram, below, shows only a few of the many accessories designed and manufactured by SK for power plant service. Generally, these accessories include those listed in the masthead. We invite you to write for Bulletin SK-1, mentioned in text. It lists all products alphabetically and identifies the literature pertaining to each.
SK Stop Valve
Motor Operated SK Non Return Valve
Motor Operated SK Non Return Valve
SK Stop Valve
SK Globe Stop Valve
Boiler
Boiler
SK Feed Water Valves
Stop Check
Throttle
Check
SK Feed Water Valves
Throttle
Stop Check
Check
SK Fuel Oil Heaters
SK Fuel Oil Pressure Regulating Valve
SK Oil Burners
SK Oil Burners
SK Automatic Oil Cutoff Valve
SK Fuel Oil Suction Strainer
SK Pressure Reducing and Desuperheating Valve
To Turbine
SK Gear Pump For Fuel Oil
SK Fuel Oil Pressure Strainer
SK Oil Cooler
STEAM
WATER
EXHAUST STEAM
FUEL OIL

You can get it from us.

For over 75 years, SK has specialized in *engineered products for the power plant.*

In that time, the company has worked closely with thousands of power and consulting engineers to properly apply accessories ranging from standard fuel oil burners to specially engineered multi-nozzle pressure reducing and desuperheating valves.

Those who don't realize the *economic importance* of years of service and wide experience belittle these intangibles.

Just you remember — the design or manufacturing problem we solved yesterday or seventy-five years ago can well provide the basis for solving a problem of your own *at lower cost* than would otherwise be possible. And, remember that every technique perfected at some previous time, every pattern, tool, and machine already on hand means *less cost to be passed along to you.*

Do you want help on some specific power plant problem? Write us, and we will have one of our field engineers visit you.

Want some idea of the many accessories we manufacture? Send for a copy of Bulletin SK-1, "Index of SK Equipment and Descriptive Bulletins," look it over, and write for the specific technical literature you need.

SCHUTTE and KOERTING Company
Manufacturing Engineers
CORNWELLS HEIGHTS, BUCKS COUNTY, PA.
REPRESENTATIVES IN PRINCIPAL CITIES

from ⅛- to 1½-in. pipe, and no adapter is needed for 2-in. pipe. An inserted pin retains the sliding plunger in working position.

The chuck is usable with a pipe machine, power drive, pipe vise or machinist's vise. Manufacturer says it soon pays for itself by converting short lengths of pipe into useful all-thread, close-thread or average nipples. A sheet metal kit box for carrying the chuck and adapters is an optional extra. Beaver Pipe Tools, Inc.

18—SPIRAL WOUND GASKETS

For applications where chemical inertness is required

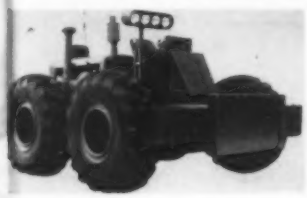
Construction of these gaskets consists of alternating plies of Teflon and stainless steel. Chief advantage is said to be the elimination of cold-flow. Trapped between edges of metal, the Teflon can't flow when bolting is applied. The flexibility of the gasket structure provides necessary resiliency for self-adjustment, company states, and assures safe sealing regardless of fluctuating temperatures at the joint.

These Teflon-filled gaskets are said to be unaffected under high pressures and can be used in the temperature range from — 90 to 500 F. They are also suggested for process applications where light bolting prevails. Available with several ferrous and non-ferrous alloys, the gaskets are made for all ASA and API joint assemblies in four thicknesses from 0.125 to 0.285 in., and built for special joint assemblies up to 104 in. dia. Flexitallic Gasket Co.

19—PUSHER UNIT

Is also adaptable for use in pulling operations

The Tournatractor is a new version of manufacturer's Super C Tournadozer with the dozer blade, power control unit, A-frame and dozer controls omitted. In place of these is a massive billet, 3 by 15 in. and spanning the width of the machine. On this billet is a pusher plate.



The Tournatractor can be equipped with a torque-converter and is equally adaptable to pulling operations, either with a rear power control unit or with its drawbar alone. Or if desired, the billet and pusher plate can be removed and the A-frame, power control unit and dozer added. A variety of tire choices is offered. R. G. LeTourneau, Inc.

20—CONTROL SYSTEM

For sewage and water level control and indication purposes

Called Thermasul, this new electrical system is designed for use in wet wells, sumps, reservoirs, elevated tanks, standpipes etc., to control pump motors, pump motor speeds and supervisory and alarm circuits.

Basically, the Thermasul element consists of a temperature-sensitive, sintered-sulfide compound around which is wound a resistance heater; the whole assembly hermetically sealed in a stainless steel tube. In air, resistance of the element is low because the heater keeps the level detector approximately 280 C above ambient air temperature. When the detector is immersed, however, the

heat is conducted away and the resistance of the element jumps up rapidly, operating a small remotely-located relay. Thus, the element acts as a switch to open and close the relay with the presence or absence of liquid.

Because of non-corrodible construction and self-cleaning characteristics the new device is said to be especially useful for unattended locations. Both straight and hooked probes are available, as illustrated above. Control Dept., General Electric Co.

21—TEMPERATURE CONTROLS

Direct or reverse acting; for heating, cooling applications

Self-operating Series V Temperature Regulators are designed to handle through the valves, steam, liquids, gases and all fluids not corrosive to brass. These regulators operate on the principle of liquid expansion. Since this expansion is proportional to increments of temperature, the valve movement is gradual. The result is a gentle, but positive throttling, where the valve supplies only enough steam or cooling medium to maintain desired control temperature.

Available in sizes from ¼ to 4 in., the regulators control temperatures between 25 and 275 F with a 50 F range of adjustment. Inlet pressure limit is 125 psig, and inlet temperature limit is 450 F. They have bronze bodies, renewable bronze or stainless steel seats and discs, and 8 in. nickel plated copper capillary and nickel plated brass bulb. Farris Stacon Corp.

22—INDUSTRIAL FAN

With air handling, materials handling or long shavings wheel

New, rugged industrial fan, made in 11 sizes, is now available for exhausting smoke, fumes, dust, sawdust, chips or long fibers. Fan capacities range from 670 to 44,000 cfm and pressures up to 16 in. water gage.

Air handling wheel has backwardly-inclined blades featuring low power consumption over wide range of volumes and pressures. Materials handling wheel is heavy duty, straight bladed, side plated and maintains high fan efficiency. Long shavings wheel is specifically designed for handling long, stringy fibers.

Standard accessories include both bolted and quick opening access doors, flanged outlets and inlets, and outlet dampers. Available with variety of special coatings, fan can also be made of special metals to meet explosion-proof or anti-corrosive specifications. Cooling accessories are available for high temperature applications. Sturtevant Division, Westinghouse Electric Corp.

Use post cards on pages 36 and 117 to ask for more information on these products

23—CAPACITOR BASE

Light weight base for metal-can capacitors is made of nylon

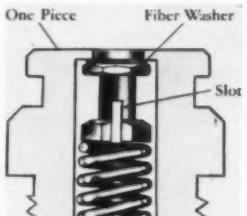
New nylon base, for metal-can capacitors of CP40 style, has improved insulation resistance, fungus resistance, and reduced likelihood of turning within the can, according to manufacturer.

Flow temperature is in excess of 480 F, heat distortion temperature at 66 psi is 400 F. Strength of nylon eliminates unnecessary material making lighter weight unit. An eyelet is provided to which capacitor lead is soldered, giving hermetic seal between base and capacitor can. Base is designed primarily for use with paper capacitors but can be used with any type using 1½-in. cans. Industrial Devices, Inc.

24—GREASE FITTING

Is giant buttonhead type, of one-piece construction

This new one-piece fitting is designed to provide maximum grease flow and prevent leakage possible with two-piece fittings which can be separated by extreme pressure or jolting. It also features a strong steel inner-spring which combines with a fiber sealing washer to prevent grease leak-back. The new giant buttonhead fitting is available in all regular sizes. Company's 1952 catalog describes it in detail. Universal Lubricating Systems, Inc.



25—AIR VIBRATOR

Vise-grip type vibrator is adapted to bench operation

Company's Type VG air vibrator has been redesigned for bench applications requiring vibration. Unit is easily installed with simple face-plate and bolts. Sturdy, steel U-shaped head functions as vise to clamp form or device to be vibrated. Serrated steel plate in head assures positive bit and rigid mounting. Area of vise jaw is 7½ sq in.

Vibrator is operated with a Type J knee valve, brass and precision machined. Valve is equipped with quick-change neoprene seat. Knee pressure can be as hard as necessary, according to manufacturer, since the valve lever is covered with sponge rubber. The Cleveland Vibrator Co.

do your boilers need?

? ADJUSTMENT OF PRE-TREATMENT

? ADJUSTMENT OF INTERNAL TREATMENT

? PROPER MEANS FOR TREATMENT APPLICATION

? BLOWDOWN ADJUSTMENT

? TEST CONTROL

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65 years of water treatment experience available to you

Since 1887, Dearborn has strived to make the problem of providing trouble-free water for users of steam as simple and economical as possible.

Today, Dearborn has every facility—plus a broad background of experience—to help every business, every plant reduce the cost of maintaining its boiler room or power plant operation.

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POWER PLANT *Construction News*

Gantt, Ala. — Alabama Electric Cooperative, Inc., Andalusia, Ala., has completed plans for first of two new steam-electric generating stations in vicinity of Gantt, each to have a capacity of 7500-kw. Work is scheduled to begin during the summer. Entire project estimated to cost about $3,200,000. Financing has been arranged through Federal Aid.

Buhne Point, Calif. — Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., plans new steam-electric generating plant at Buhne Point on Humboldt Bay, Northern California, where site has been selected. It will be equipped with a 40,000-kw. turbine-generator unit, high-pressure boilers and auxiliary equipment. Cost reported about $10,000,000, with switching stations, transmission lines and other operating facilities. Proposed to begin work early in 1953.

Redondo Beach, Calif. — Southern California Edison Co., 601 West 5th St., Los Angeles, Calif., has plans maturing for new steam-electric station at Redondo Beach supplementing present power plant at that location. New station will have an ultimate capacity of 600,500-kw. Present installation will consist of two main generating units, each of 156,250-kw. capacity, the first of which is scheduled for completion in 1954. Entire project will represent a reported investment of about $80,000,000. Immediate work is estimated to cost approximately half that sum.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., has made application to Federal Power Commission, Washington, D. C., for permission to construct two hydroelectric generating plants on North Fork of Feather River and Butt Creek, Plumas County. Proposed stations will be equipped for a rated capacity of 205,000-hp. and are estimated to cost about $36,000,000. Proposed to begin work as soon as permission has been secured.

Cutler, Fla. — Florida Power & Light Co., Miami, Fla., is reported planning early construction of new steam-electric power plant in vicinity of Cutler, with cost approximating $8,800,000, including power substations, transmission lines and other operating facilities. Project has been approved by Defense Plant Administration, Washington, D. C.

Orlando, Fla. — Tupper Corp., Farnumsville, Mass., plastic products, plans boiler house in connection with proposed new plant on site near Orlando, recently acquired. Entire program will represent a reported investment of about $1,000,000. Work on superstructure will begin soon. Earl S. Tupper is president.

Plymouth, Fla. — American Can Co., 100 Park Ave., New York, N. Y., plans boiler house in connection with proposed new plant at Plymouth, Fla., for production of tin cans for food packaging. It will total about 220,000 sq. ft. floor space, and is reported to cost over $1,800,000.

Danville, Ill. — Federal Chemical Co., Starks Bldg., Louisville, Ky., plans boiler house in connection with new plant on 48-acre tract of land at Danville, for manufacture of commercial fertilizer. Entire project reported to cost close to $1,000,000. Proposed to begin work soon.

Plainfield, Ill. — Hazel-Atlas Glass Co., Jacob St., Wheeling, W. Va., glass containers of all kinds, will build a boiler house in connection with proposed new plant at Plainfield, where tract of about 75 acres of land has been secured. Factory will consist of several buildings, and is reported to cost close to $3,500,000. Work is expected to begin soon.

Covington, Ind. — Olin Industries, Inc., Alton, Ill., plans power house at proposed new plant on tract of over 600 acres of land at Covington, for manufacture of cellophane. It will comprise a group of one and multi-story units, and is reported to cost close to $20,000,000. Proposed to begin work at early date.

Greencastle, Ind. — International Business Machines Corp., 500 Madison Ave., New York, N. Y., typewriters, tabulators, and other business machines, plans power house at proposed new branch plant at Greencastle, where tract of over 50 acres of land near city limits has been selected. It will comprise several buildings, and is reported to cost close to $3,500,000. Proposed to begin work soon.

Luling, La. — Lion Oil Co., El Dorado, Ark., refined petroleum products, gasoline, etc., plans power house at proposed new plant at Luling, near New Orleans, where site has been secured, fronting on Mississippi River. New factory will be used for manufacture of line of petrochemicals. Entire project will represent a reported investment of about $30,000,000. Program has been approved by National Production Authority and work is scheduled to begin soon.

Detroit, Mich. — Proposed expansion in main power plant at local automobile works of Hudson Motor Car Co., Conner and Kercheval Aves., Detroit, is reported to cost close to $2,500,000, instead of smaller amount previously noted in these columns. Work will consist of new turbine-generator and accessory equipment, three high-pressure boilers, each with rating of 100,000 lbs. per hour of steam, and auxiliary equipment. Project will be placed under way soon.

Crookston, Minn. — American Crystal Sugar Co., Boston Bldg., Denver, Colo., beet sugar, plans power house at proposed new mill at Crookston, where large tract of land has been selected. Factory will consist of a number of one and multi-story buildings, and will be equipped for processing about 3000 tons of sugar beets per day. Cost reported in excess of $5,000,000. Proposed to have plant ready for service before close of 1953. John A. Sumerton is executive vice-president.

Pleasant Hill, Mo. — Missouri Public Service Co., Warrensburg, Mo., has plans under way for expansion in steam-electric generating plant at Pleasant Hill, with installation of a new 27,000-kw. turbine-generator unit, high-pressure boilers to operate under a pressure of 200 lbs. of steam per hr., and auxiliary equipment. Entire project is reported to cost close to $5,000,000. Work is scheduled to begin at early date.

Albuquerque, N. M. — Public Service Co. of New Mexico plans expansion in power plants and system to cost about $4,625,000, including additional generating equipment, power substations, transmission lines and other facilities. Project has been approved by Defense Production Administration and work will be carried out at once.

Potsdam, N. Y. — Niagara Mohawk Power Corp., Buffalo, N. Y., has authorized immediate construction of new hydroelectric generating station on Raquette River, near Potsdam, comprising the first of five such stations to be constructed in that vicinity. Complete project will develop a total installed capacity of 90,000-kw., and is estimated to cost approximately $22,000,000, with power substations, transmission lines, and other operating facilities. Completion of development is scheduled in May 1957. This is part of a large expansion program of company for increased generating capacity, which will include new steam-electric plant at Albany, N. Y., with rating of 320,000-kw.; addition to steam-electric station at Buffalo, with rating of 160,000-kw.; and hydroelectric power plant on Sacandaga River, to develop a capacity of 30,000-kw.

Poughkeepsie, N. Y. — Central Hudson Gas & Electric Corp., Poughkeepsie, will expend about $10,960,000 for expansion in electric generating facilities. Program has been approved by Defense Production Administration and will proceed at once. Work will include extension in steam-electric power plant at Danskammer Point, near Newburgh, N. Y., previously referred to in these columns, where a new 60,000-kw. turbine-generator will be installed.

Cleveland, Ohio — Cleveland Cap Screw Co., 2917 East 79th St., screws, bolts, cap screws and kindred products, plans boiler house at proposed new plant on local site in vicinity of Miles Ave., and Lee Rd. It will comprise a main one-story building, about 300,000 sq. ft. floor space. Entire project reported to cost approximately $3,000,000. H. M. Morse & Co., 3334 Prospect Ave., Cleveland, are engineers.

Philadelphia, Pa. — Board of Directors, Northeastern Hospital, Alleghaney Ave. and Tulip St., has plans for new boiler house at institution, for central-heating service. Work will be carried out in connection with a general expansion program at hospital, including mechanical laundry and other structures. Entire project reported to cost about $850,000.

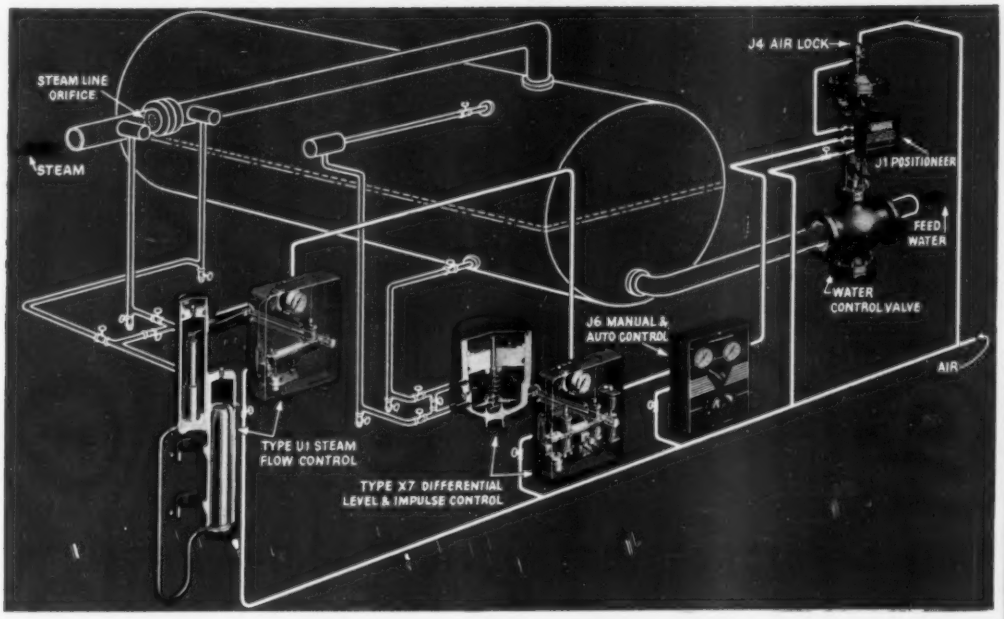
Gallatin, Tenn. — Yale & Towne Mfg. Co., 405 Lexington Ave., New York, N. Y., locks, builders' hardware, etc., plans boiler house at proposed new branch plant at Gallatin, where tract of land is being secured. It will comprise a main one-story building for general production and several auxiliary units. Cost reported close to $1,000,000.

Beaumont, Tex. — Gulf States Utilities Co., 362 Liberty Ave., plans extensions and improvements in steam-electric generating plants for increased capacity. Program reported to cost about $8,500,000, with turbine-generators and auxiliary equipment, power substations and other operating facilities.

Colorado City, Tex. — Texas Electric Service Co. is reported planning new steam-electric generating station in vicinity of Colorado City. Details of design and equipment installation are being arranged. Entire project will represent a reported investment of about $7,500,000, including power substations, transmission lines and other operating facilities.

Elkton, Tex. — Texas Power & Light Co., Interurban Bldg., Dallas, Tex., plans new steam-electric generating plant in vicinity of Elkton, with turbine-generator, high-pressure boilers, and auxiliary equipment of capacity now being determined. Project is reported to cost about $3,900,000. It is understood that work will be carried out at early date.

Swartwout Impulse Regulation assures correct feed water supply under any load condition



SWARTWOUT two-element controls—by utilizing the very forces that cause false drum level—produce a corrective impulse that assures correct level even under rapid load swings. Since "shrink" and "swell" are functions of *rate of change*, as well as magnitude of load, only Impulse Regulation gives satisfactory operation under *any rate of change in load of any magnitude.*

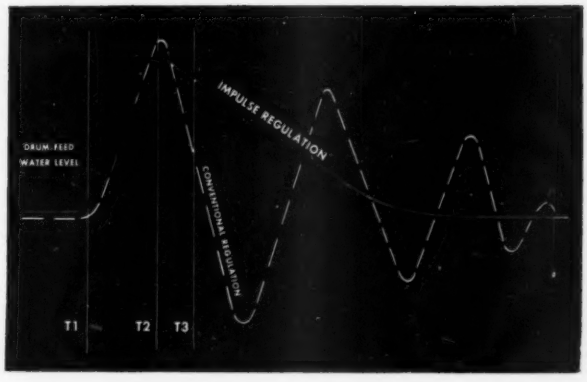
Type U1 flow transmitter takes square root of steam line orifice differential and feeds airloading pressure, which is directly proportional to steam flow at all flows, to X7 differential level and impulse control. X7 unit positions flow valve by sending airloading pressure which is result of combining *rate of change* of steam flow function with water level.

Graph *(right)* shows how proper combination of these forces, plus reset and setback features, assures that valve will give desired operation under *any* load condition. System can be adjusted to maintain drum level constant at all loads, carry it high at high loads, low at low loads, or vice versa. In addition to this FW6 two-element system, Swartwout also makes an FW7 three-element impulse regulating system. Other types include FW5 single-element system and SC (FW1) thermo-hydraulic system.

A-3758

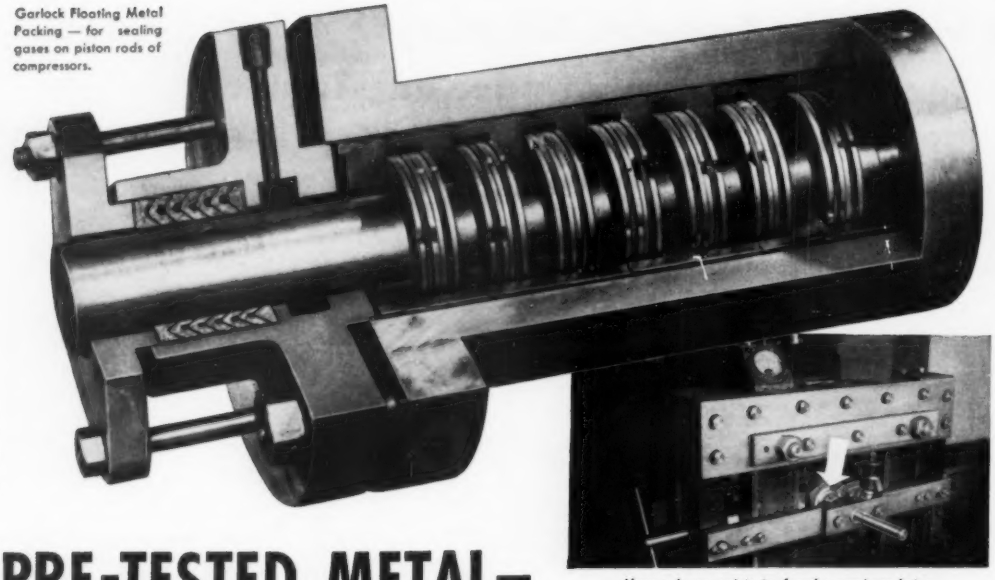
Swartwout

POWER PLANT EQUIPMENT



SEND FOR BULLETINS S-27, S-20-E • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

Garlock Floating Metal Packing — for sealing gases on piston rods of compressors.



PRE-TESTED METAL—

Above: Arrow points to foundry specimen being wear-tested on specially designed machine.

Your assurance that Garlock Metal Packings are right for the job!

Designed specifically for high pressure and high temperature service to seal air, ammonia, steam or any gas on piston rods of compressors and steam engines, Garlock Metal Packings are quality-controlled throughout their entire manufacture.

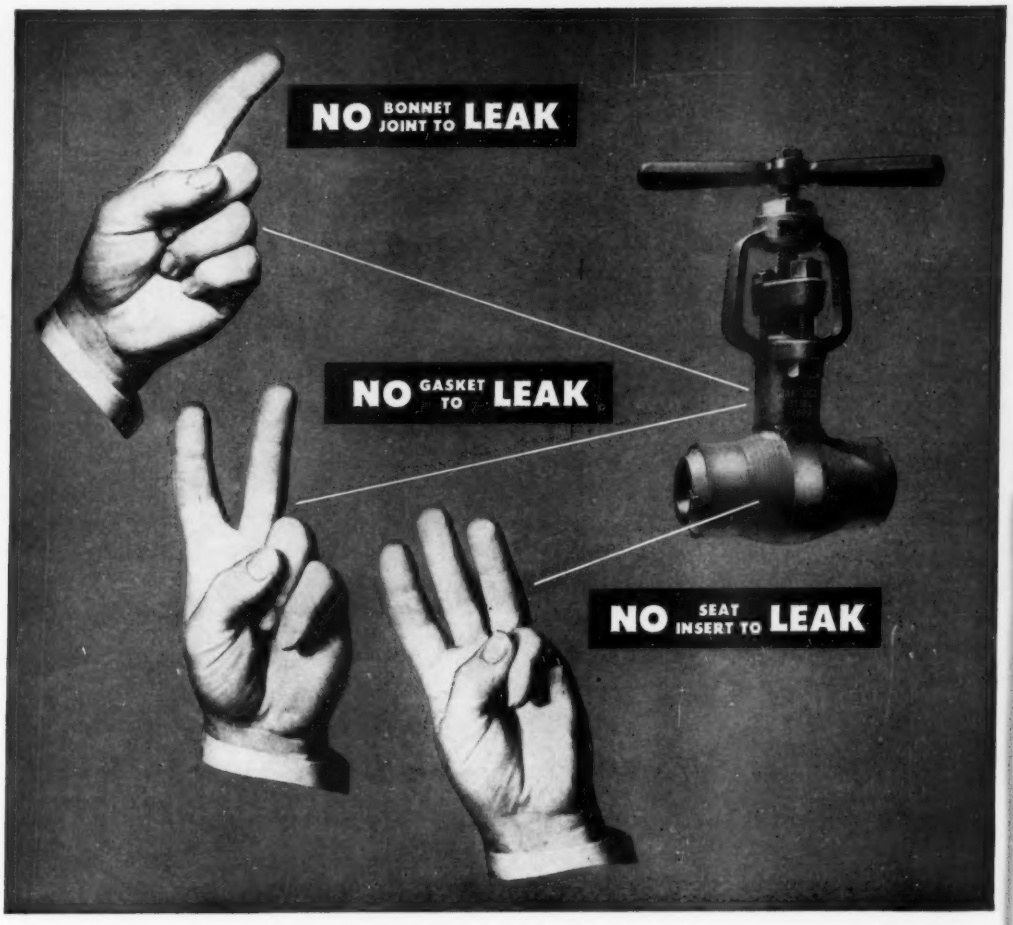
Starting with the metals of construction, every "heat" of cast iron and bronze is accelerated-wear-tested on a special machine by an independent organization before the materials are shipped to Garlock. If the wear test specimen does not pass Garlock's rigid standards, then the entire "heat" is rejected.

Then, using these tested, high-grade materials, Garlock Metal Packings are accurately machined to exacting specifications by experienced craftsmen. Throughout every operation extreme precision is the watch-word.

The product of this rigid pre-testing and precision manufacture is a metal packing that you can be sure will meet your service requirements. So, standardize on Garlock Metal Packings—they last longer, require less maintenance.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK FLOATING METAL PACKINGS



HANCOCK 1500# and 2500# WELDVALVES are designed specifically for high-pressure, high-temperature steam plants – are safe, dependable in the severest service. No bonnet joint, gasket or seat insert to cause trouble. The life of the integral stellite seat and disc is permanent. Self-compensating yoke protects seat and disc against wire drawing leaks and damage. No excess weight to create piping strains – compactness saves space. The valve stays in the line for servicing.

Two valve bodies (¾" and 1½") take care of all pipe sizes from ¼" through 2" – simplify inventory and maintenance. Service rating up to 2500# W.S.P. – 1050°F., and 6000# O.W.G. – 100°F.

End the costly hazards of valve leakage. Install safe Hancock WELDVALVES. Call your nearby Hancock Distributor for prompt delivery

When Hancocks go in, valve costs go down

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

*QUARTER-MILE ROADBED...sun-baked, ice-swept...*YET STILL ON THE MOVE AFTER 14 YEARS OF COAL HAULING SERVICE!!!

Photographs may not lie; but, here's one that falls far short of telling the whole truth about the remarkable performance records chalked up by this Republic Rubber's Coal Handling Conveyor Belt.

But, then it's quite a story! You can see for yourself there's lots of sky overhead and that means sun . . . constant, unrelenting sun beating down on the conveyor belt surfaces, until seasonal changes bring about onslaughts of rain, snow and sleet.

The load, of course, is coal . . . an abrasive, mine run coal that's dropped through chutes and carried by the belt to stockpiles located throughout the dock area.

With these facts in mind and knowing that when the ship moves out, there's nothing to protect the belt against spraying lake water, consider this:

The belt is now fourteen years old and still going strong!!!

Purposefully, we've left the photo unretouched to show you just what a 14-year old Republic Rubber Conveyor Belt really looks like . . . to show you just how well a Republic Conveyor Belt stands against the ravages of time, hard labor and all the elements can throw at it. Incidentally, the dark spots you see on the belt's surface aren't worn places at all. That's water . . . water that makes ordinary conveyor belts mildew and prematurely fail, but holds few terrors for Republic Conveyor Belting because they're "mildew-proofed"!

It's to your advantage to learn why Republic Conveyor Belts like this can year in, year out, many times outperform and outlast other brands of belting.

Despite abrasion, impact, flexing, weathering or contact with heat, oil and chemicals, Republic Conveyor Belts continue to be your best insurance against breakdowns, short life and high handling costs.

Write us today for the name of your local Republic Rubber Distributor who can offer expert advice and fast service on all industrial Rubber Products.

Remember, whether it's hose, belting, packing or any one of hundreds of different molded and extruded specialties . . . **if it's built of rubber, Republic builds it better!**

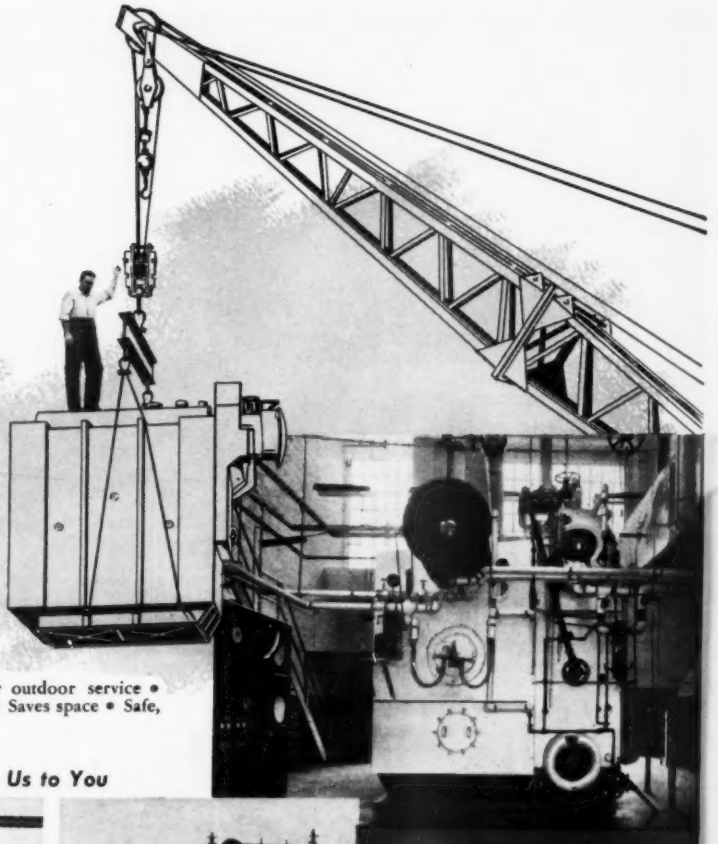
REPUBLIC RUBBER DIVISION

LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1, OHIO

INDUSTRIAL RUBBER PRODUCTS

IF YOU WANT TO

Bring Steam Costs Down



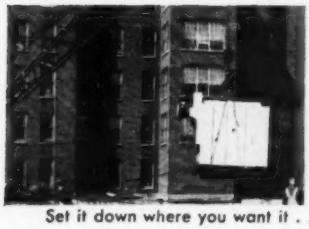
CONSIDER THIS
Factory-assembled, Self-contained B&W Integral-Furnace Boiler, Type FM

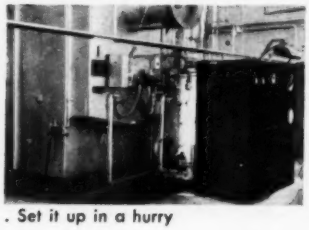
• Saves erection time and cost • Meets wide range of services • Handles quick load changes • Fast steaming • Low maintenance • Easy accessibility • Suitable for outdoor service • Burns oil and or gas • Saves fuel • Saves space • Safe, automatic operation.

Steam Capacities 2900 to 28,000 lb. per hr. at 15 to 250 psi

It Is Easily Shipped from Us to You

By Truck . . By Rail





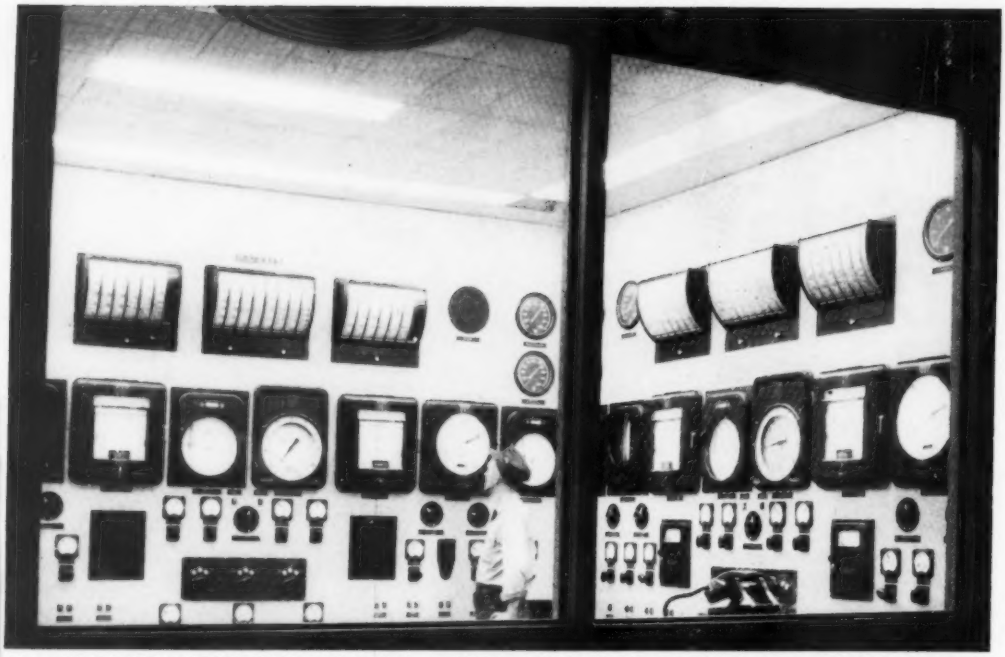
Set it down where you want it . . . Set it up in a hurry

There's no law against buying more than one FM unit if you need BIG BOILER capacity. Many companies have, and pocketed the money they would otherwise have spent tearing their buildings apart to put in a large boiler. Ask your nearest B&W man to explain the economical service you can expect from Type FM boilers . . . or send for Bulletin G-76.

THE BABCOCK & WILCOX COMPANY
BOILER DIVISION
85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-564



AIR CONDITIONED CONTROL ROOM ILLUSTRATES COMPLETE BOILER PLANT INSTRUMENTATION SUPPLIED BY HAYS.

MULTIPLE FUEL COMBUSTION CONTROL OF CYCLONE FURNACES

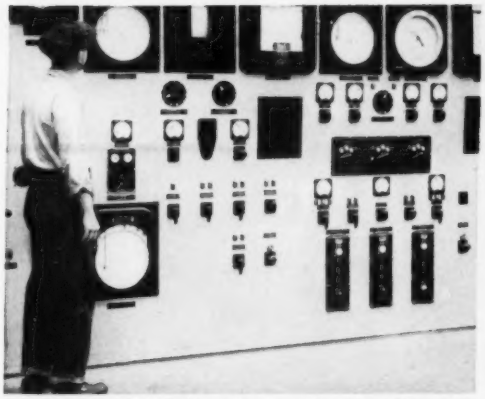
At Michigan City Station of Northern Indiana Public Service Co.*

Flexible, efficient, safe firing of *both* coal and gas in cyclone furnaces is being achieved at the Michigan City, Indiana generating station of NIPSCO* by means of an electric combustion control system designed and built by engineers of The Hays Corporation working closely with company officials and the consulting engineers, Sargent & Lundy.

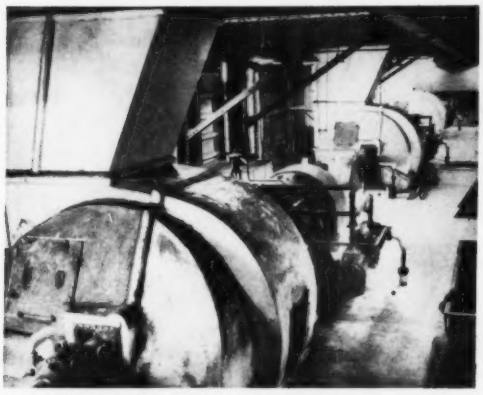
The system permits any desired allocation of load among the three boilers, between the two cyclone furnaces of a given boiler and between the two fuels being burned simultaneously in a given cyclone. Thus, any conceivable load-need or fuel supply situation can be accommodated.

In addition, complete safety for the multi-million dollar installation is "built in" since each boiler is equipped with a system of mechanically and electrically interlocked selector switches arranged to require a definite sequence of operation in transferring from manual to automatic control and vice versa. For example, interlocks require that (1) the ID fan must be running (2) the ID fan damper must be partially open and (3) at least one of the FD fan duct dampers must be opened before the FD fan can be started.

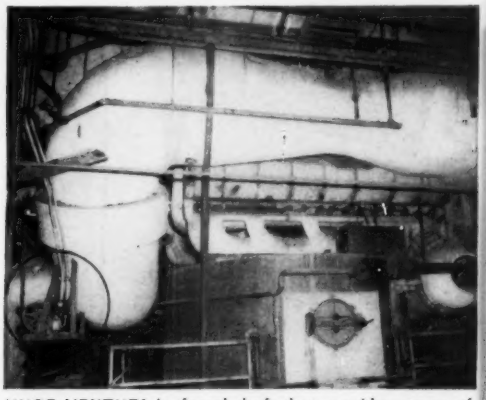
This installation illustrates the care and ingenuity exercised by Hays engineers in solving the combustion control problems of boiler plant operators throughout the world—regardless of boiler size, fuels being burned, etc. Write for a free, fully illustrated, 8-page story on this central station—available from The Hays Corp., Michigan City, Indiana.



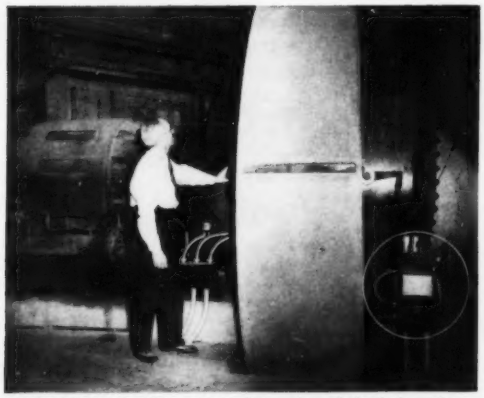
SPACE SAVING is achieved by mounting all position indicators, manual control stations, fuel-air ratio adjustments, and mechanical interlocks for one boiler inside control room near related instruments for convenience of operator (*at left*); controllers themselves are grouped on outside wall of control room for ease of inspection and maintenance (*at right*).



CORRECT FURNACE DRAFT is maintained by controlling induced draft fan inlet damper as well as induced draft fan speed. Latter is accomplished by means of hydraulic coupling equipped with reversing oil pump.



HUGE VENTURI in forced draft duct provides means of accurately measuring air to individual cyclone. The Hays power unit *(indicated within circle)* operates a damper in this forced draft duct.



THREE 120,000 CFM, motor driven forced draft fans (one for each boiler) provide air for cyclones at 54" water pressure. Hays power unit (*circle*) adjusts forced draft fan inlet damper in response to forced draft duct pressure controller.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Venflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders

THE hays CORPORATION

MICHIGAN CITY 7, INDIANA

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH R/M

You will find Raybestos-Manhattan packings and gaskets in machines like this reciprocating boiler-feed pump, and in practically every other type of fluid-handling equipment in industry. The long line of R/M packings and gaskets is relied on by experienced engineers, not only for pumps, but for valves, compressors, expansion joints, hydraulic rams, and wherever trouble-free service is essential. The R/M distributor near you will gladly help you select the right packing or gasket for your needs. Or write for the R/M Packing Catalog.

FOR R/M "TEFLON" PACKINGS, GASKETS, SHEETS, RODS, TUBES, SEE YOUR R/M DISTRIBUTOR

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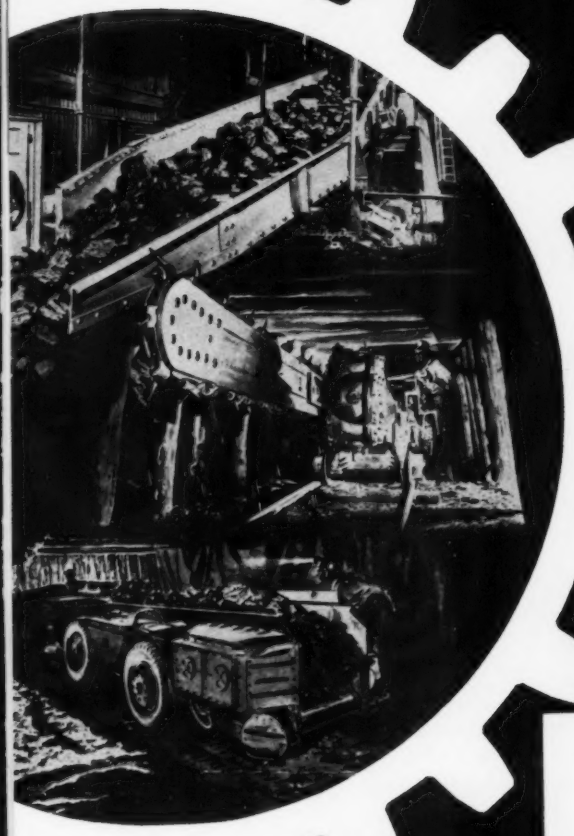

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IN FAR OFF INDIA IT'S YARWAY

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NEPAL

P

BOKARO STATION WILL USE 24 YARWAY UNIT TANDEM BLOW-OFF VALVES

India's great new Bokaro Station — the largest steam power plant in the Far East — will have its eight 300,000 lbs. per hour steam generating units equipped with Yarway Unit Tandem Blow-Off Valves.

Bokaro was engineered and constructed by The Kuljian Corporation — who know that the good design, quality materials, and careful workmanship of Yarway Blow-Off Valves mean *dependable service*, so important in modern power plants. That is why *4 out of 5 high pressure boiler plants today are equipped with Yarway Blow-Off Valves.*

Yarway engineers, trained and experienced in solving steam plant problems, are located near you. When you need help—call a Yarway man.

YARNALL-WARING CO.
114 Mermaid Ave., Phila. 18, Pa.
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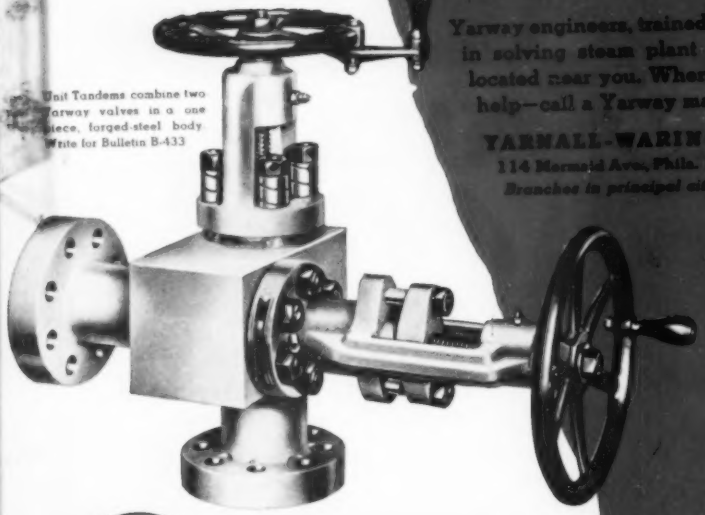
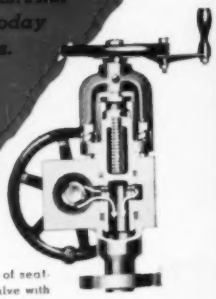
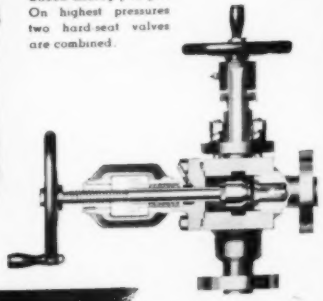


Unit Tandems combine two Yarway valves in a one piece, forged-steel body. Write for Bulletin B-433



Cross section of seatless sealing valve with famous Yarway balanced sliding plunger. On highest pressures two hard-seat valves are combined.



Cross section of hard-seat blowing valve with mated stellite-faced disc and integral welded-in stellite seat.

... YARWAY SERVICE GOES ALL THE WAY

Power Plant Calls

With The Editors

THE NEW SUPER-DUPER plants with their 1,000,000-lb-per-hr boilers and huge electric generators with their electronic gadgetry are interesting . . . but so are the old plants with equipment installed half a century ago still chugging away . . . Traveling through the middle west — indeed, in other regions as well — one comes across many such plants . . . The old-time machinery was built to last — some of it a little too well, perhaps.

★ ★ ★

At the power plant of French & Hecht Co., a division of Kelsey-Hayes Wheel Corporation in Davenport, Iowa, we found a Nordberg steam-driven air compressor installed 42 years ago still clicking away merrily. Charlie Brusso, the Power Plant Supervisor, says it is not as economical in its use of steam as it once was, but it is still in excellent mechanical condition, and helps out when the three motor-driven compressors cannot carry the load or when one of them is down for overhaul . . . An old plant with two Edge Moor boilers equipped with Laclede stokers, but kept in good condition by a very capable engineer.

★ ★ ★

There are even a few old jet condensers still left . . . Found one at Consolidated Water Power and Paper Co. at Wisconsin Rapids, and others at the Oshkosh Steam Plant of Wisconsin Public Service . . . The latter is an interesting station from a historical standpoint — almost like a museum. One old turbine generator dates back to 1918, and on the electrical side there are still a few old constant-current transformers in operation on series street lighting circuits . . .

These machines have always been intriguing — few electrical gadgets were ever more obvious in their principle of operation. The Oshkosh Steam Plant was shut down at the time of our visit because of an excess of hydro power on the system; but, when called upon, this old equipment still helps to carry the load . . . W. C. Hitchcock is the present chief engineer. G. J. Morrison, the former chief engineer, is now at the Bayside Station at Green Bay.

★ ★ ★

Oshkosh of course is well known as the place where the famous overalls are made . . . Oshkosh B'Gosh, Inc . . . but it has plenty of other industries ranging all the way from matches (Diamond Match Co.) to Diesel engines and trucks . . . Several breweries too. At the Peoples Brewing Co. we found a very nice, small, new boiler plant, very neat and very efficient. Mr. Schoenrock is Superintendent of Power. The plant consists of two 6000-lb-per-hr B & W integral-furnace boilers fired by Detroit stokers . . . An ingenious screw type coal conveyor has eliminated all the old drudgery of hand firing.

★ ★ ★

On a side trip to Hennepin, Ill. we looked over the construction of Illinois Power Co.'s Hennepin power station. Mr. Keck, the supervising engineer on duty, gave us a short account of the work . . . Plant will have an ultimate capacity of 240,000 kw . . . The foundations were in, and some of the steel work was being erected . . . Interesting note: Station will not have a basement.

★ ★ ★

Skirting the Hoosier state on our way back from somewhere, we stopped at the American Coating Mills at Elkhart where we found a small but very well designed and operated power plant . . . Three turbines generating units, one condensing and two non-condensing, totaling 7000 kw . . . Two main boilers each of 100,000 lb per hr capacity fired by chain grate stokers . . . V. R. Elliott, Power Plant Engineer, is in charge of operation and showed us some interesting details . . .

For example, an unusual level indicator for the hot-well that shows the water level above in the turbine room . . . some water cooling tricks on the ash hopper gates that are very effective, and a small auxiliary boiler fired by a small pulverized coal system . . . Another thing of interest was an unusual arrangement of sprays in the ash discharge from the storage tank to keep down dust . . .

In his office, Elliott has an ingenious storage wall, from which a practical drawing board unfolds, and in which he can store charts and records . . . Other features we'll describe to you in detail in a future article . . . Over on the side of this page, however, we show you a picture of the station . . . Nice place to go fishin', wot? . . . Oh, yes; the American Coating Mills power plant was rebuilt in 1940 with H. W. Wilson of Philadelphia as consultant.

Women! Women everywhere these days . . . driving taxis, running lathes, doing drafting, in fact almost anything you can think of . . . But now it seems they are invading even the power plant . . . We heard of it some time ago — just a rumor we thought, but by golly, now we find it's true . . . SARA is her name and they are giving her a job in the new Johnsonville plant of TVA . . . SARA'S quite a strange gal, however — nothing you would go for in an amorous way . . . She weighs almost 5000 lb, and is shaped somewhat on the order of a grand piano . . . She's smart though — her brain is 12 ft long by 7 ft high.

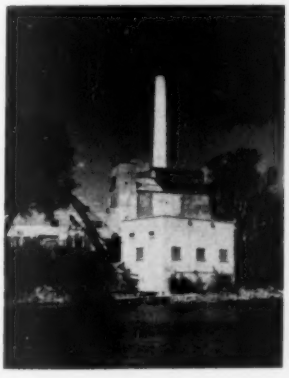
All right, all right then . . . she isn't a real gal. SARA is an electronic trouble shooter. Her technical name is Sequential Automatic Recorder and Annunciator and she was designed to provide split-second trouble shooting in the spaghetti-like electrical mazes of modern power plants. SARA may be the first of a long line of sequential memory recorders in power plants . . . The practice of hooking up a large number of vital operating points to a central control panel is, of course, old stuff.

For years, however, there has been a deficiency in the system. When some device fails, a whole sequence of events takes place at all points and the sequence happens so fast that the whole thing looks just like one big flash.

This is where our gal SARA comes in. She can detect as many as 400 types of occurrences, and she reports and records when and where conditions occur and when operations are restored to normal. SARA is a sort of electro-mechanical newspaper, complete with reporters, editorial desk and printing plant.

★ ★ ★

From the river — the famous St. Joseph River by the way — which supplies the paper mill and power plant with the necessary water, a somewhat romantic view of the American Coating Mills power plant, with the pump house in the foreground, appears like this.



Meeting America's

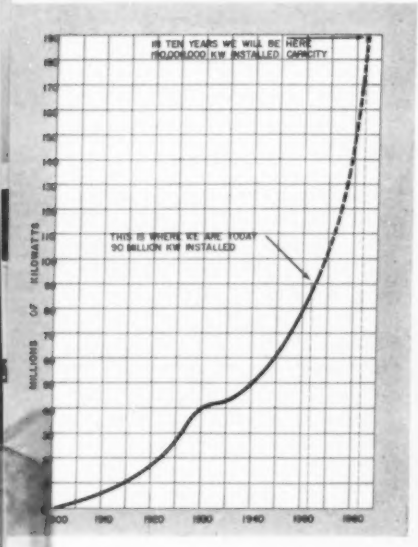
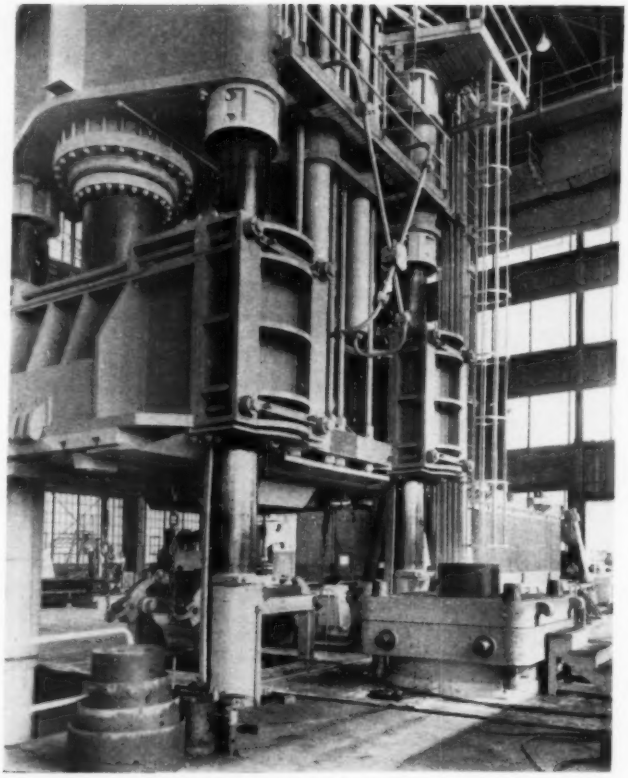


Fig. 1. This curve shows the growth in electric generating capacity in the United States during the last fifty years and the projected capacity for the next ten years. During the past 40 years, the generating capacity has doubled every decade, and indications are, that this rate of growth will continue until far in the future. By 1962, we will need approximately 190 million kilowatts. This means that in the next ten years we will install approximately as much capacity as was installed in the entire first half of this century in the U.S.A.



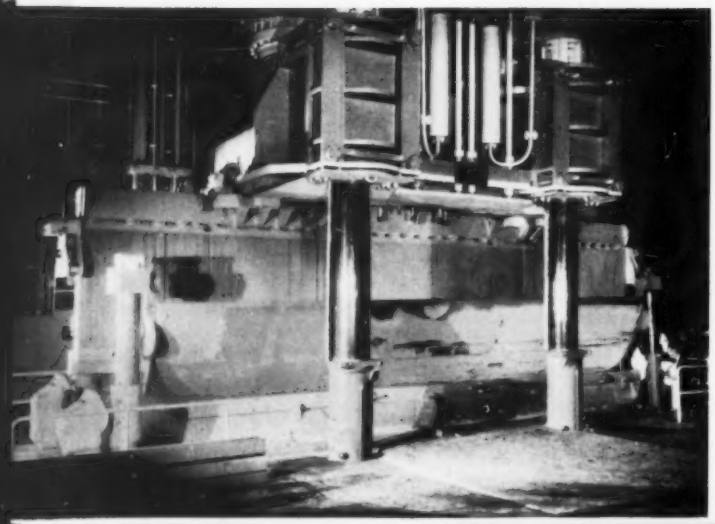


Fig. 2 (Above) This is the great vertical press at the Barberton, Ohio, works of the Babcock & Wilcox Co., set up for ingot piercing — first step in the formation of a hollow forging. The ingot is placed in the piercing pay (right) which slides in under the press where it is pierced by the ram

Fig. 3 (Left). In this view the same press shown in Fig. 2 is set up to shape the heaviest plate ever rolled into a boiler drum section. This plate, shown in the press, is 35 feet long, ten feet wide, and 6 inches thick. This red hot sheet, weighing some 42 tons, is handled by four hydraulically-controlled manipulators at the corners of the movable be!

Vast Need For Power Equipment

ONE of the significant characteristics of the first half of the present century is the phenomenal increase in the use of power in all aspects of our life. As shown by the curve in Fig. 1, which represents the installed electric generating capacity in both central stations and industrial power plants, the amount of capacity has approximately doubled every decade, and at present we have installed some 90 million kilowatts. About 75 million of this is in central stations.

All indications are that this rate of growth is not slowing down; indeed, if anything, it is increasing at even a faster rate. Both the Federal Power Commission and the Edison Electric Institute have made studies which indicate that by 1962 we will need just about double the capacity we have today. In other words, in the next ten years we will have to install as much new generating capacity as we installed during the entire first 50 years of this century.

There has been some apprehension as to whether the equipment manufacturing capacity of the country can supply this vast amount of power equipment, but those who know American industry best — the equipment manufacturers themselves — do little worrying about it; they are translating the predicted power curve into action.

On these two pages we present dramatic evidence showing how one of America's great boiler equipment manufacturers is planning for future needs — The Babcock & Wilcox Co. These pictures show views of the nation's largest press for forming boiler drum plate and for piercing ingots in the production of heavy-wall hollow forgings. At a demonstration of this equipment before a group of technical editors and newspaper men on July 22, Alfred Iddles, President of Babcock & Wilcox Co. said it was an important part of the 30 million dollar expansion program which has been in progress by B & W since the close of World War II, and which is geared to meet the needs of the power industry for larger and more powerful boilers. During the demonstration, the press formed into a drum section the heaviest steel plate ever rolled. This plate was 35 ft long, 10 ft wide, and 6 inches thick. It weighed 42 tons. This great hydraulic press, which was built by B & W, together with a draw bench for producing hollow steel forgings, is installed in a new shop building, 105 by 275 ft and 92 ft high at the Barberton works of the company.

In addition to this new shop at Barberton the expansion program has included the inauguration of three new plants in the Boiler Division of the company, one at Wilmington, N. C., one at West Point, Miss., and a third in process of erection at Paris, Texas.

The Barberton press is capable of bending plate up to 42 ft long. As it takes approximately as long to bend a 10-ft section as a 42-ft length, the saving in forming a drum 84 ft long from two 42-ft sections as opposed to shorter sections is readily seen.

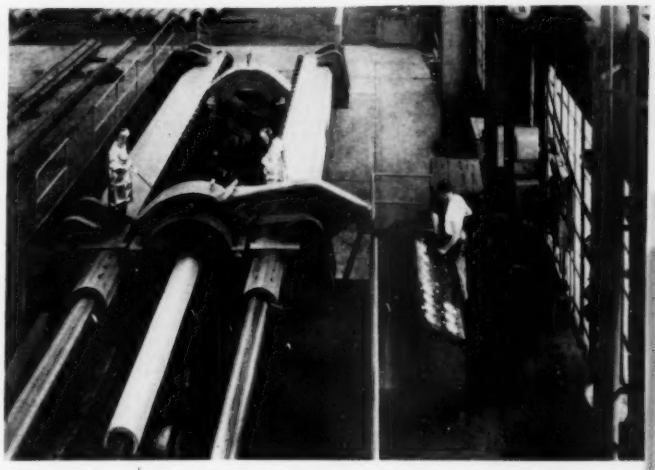
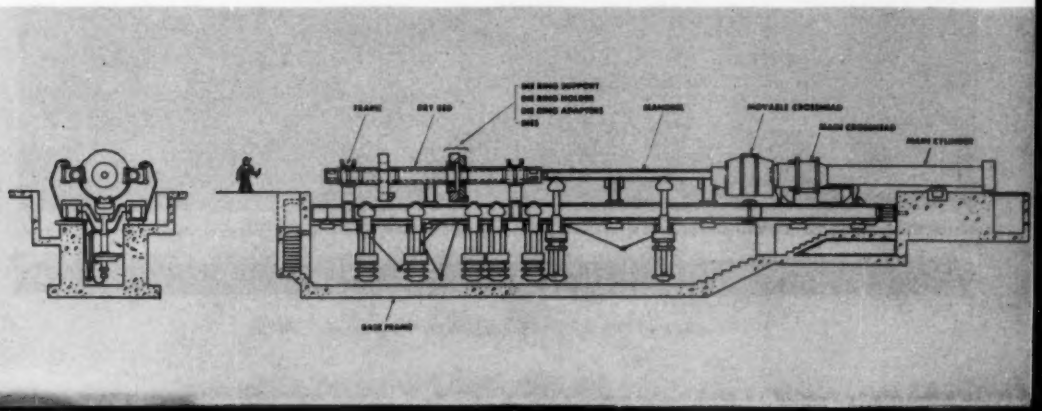
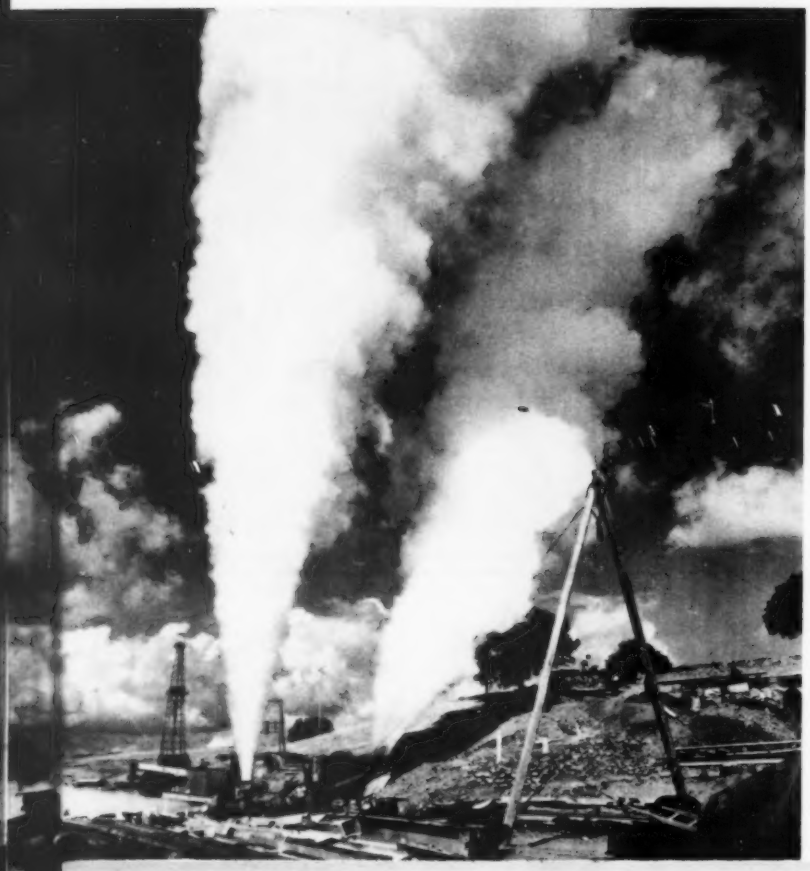


Fig. 4. Drawing a hollow forging on the horizontal draw bench at the Babcock and Wilcox plant at Barberton. The forging (foreground) is forced by the mandrel through a series of ring dies to produce a predetermined inside and outside diameter. A cross section of this draw bench is shown in Fig. 5 below

Fig. 5. Longitudinal and end sections of the new horizontal draw bench at the Barberton works of the Babcock & Wilcox Company which is shown in Fig. 4

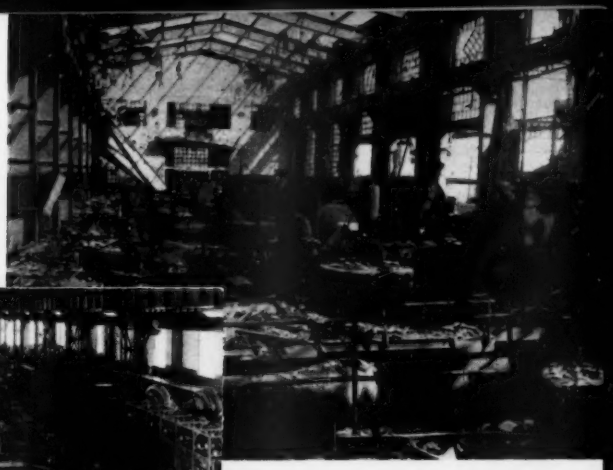


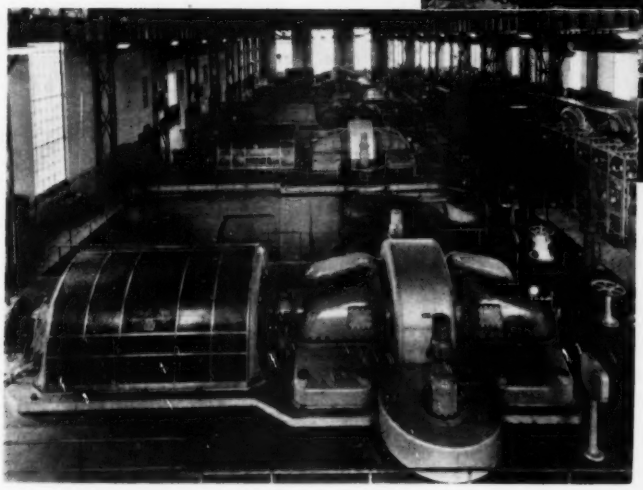
Geothermics in the *NEWS*



Larderello area—where Italy produces a large block of her power plus chemical by-products by harnessing super-geysers of natural steam from the earth

REEL





In 1944 German troops retreating to the north completely destroyed Larderello power plants and co-existent chemical plants, whose prewar average yearly production was normally 908,000,000 kwh plus tons of boric acid (top). Wartime recovery is typified by new station, Larderello No. 3, the system's biggest. Its four 30,000-kva, 10,500-v, 60-cycle turbine generators operating on natural steam at 68 psi and 437 F produce 2,500,000 kwh daily. This station, feeding a 120-kv network, furnishes 75 per cent of area's prewar power need

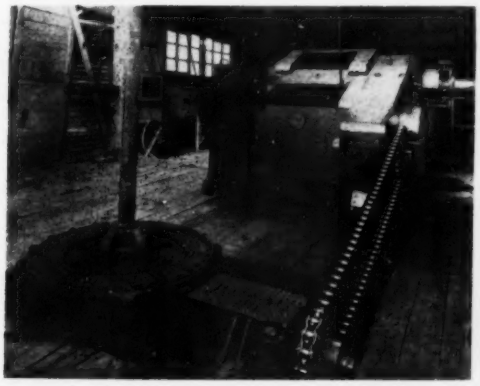
LARDERELLO, Italy, is the center of one of the world's strangest phenomena—boric fumaroles. They gush, almost exclusively and continuously, natural superheated steam. Steam temperature is 290 to 400 F, pressure 71 to 390 psi.

In 1904 the steam was first used to generate electric power—lighting 5 electric lamps. Today Larderello power stations have an installed capacity of 254,000 kw, and daily production exceeds 5,000,000 kwh. However, exploitation of nature's steam generators has not been without setbacks—natural obstacles as well as World War II, in which the plants were destroyed.

Now large drilling equipment from the U. S. capable of drilling far deeper wells, modern steam turbines with improved efficiency, chimney-type wooden coolers to solve water scarcity, and aluminum conductors to resist the acidic air are all contributing to advancement.

Today, even though 94 per cent of Italian power is produced by hydroelectric plants, prolonged dry seasons make hydro power very unreliable. It is, therefore, economically important that steam flow from the fumaroles is continuous.

This article combines data and photos from the following: Alfred Mazzoni, Mgr., Societa Larderello; Guiseppe Donato, Ercole Marelli Co.; and National Supply Co.



Drilling rig (left) which sank world's largest steam well—Larderello No. 82 (right), which belches forth 660,000 lb of steam per hour at 100 psia and 437 F

1852

Centennial of Engineering

1952

The Centennial of Engineering commemorating the founding, 100 years ago, of the first society of civilian engineers, brings to Chicago this month the greatest convocation of engineers ever held anywhere in the world. Sixty-one engineering societies and delegations from all over the world will participate

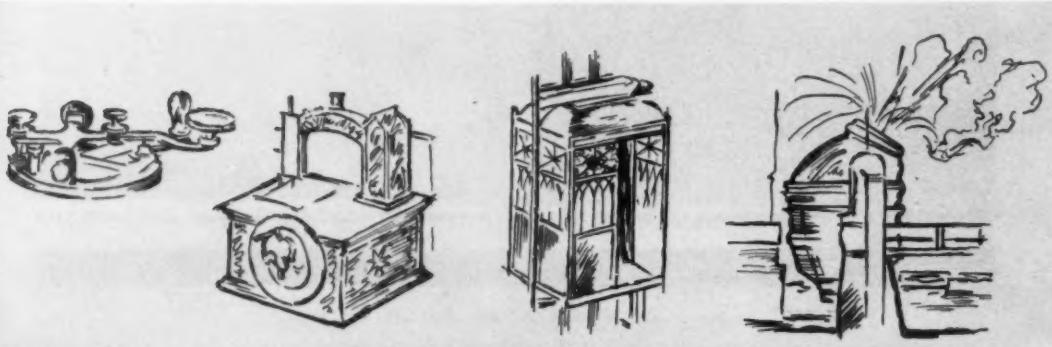
THE CENTENNIAL OF ENGINEERING being celebrated in Chicago this month, and continuing throughout the year, marks the hundredth anniversary of the formation of the American Society of Civil Engineers. Engineering, of course, is much older than a hundred years; indeed, it goes back almost as far as we have reliable records of the human race. Certainly, the building of the pyramids in Egypt and the building of the Great Wall in China were feats of engineering that are still considered remarkable. The beginnings of the modern steam engine go back some 250 years. Hero conceived the idea for his turbine around 120 B.C.

In this country, before 1852, however, nearly all the organized *engineering* was handled by military men. All the surveying of national lands, the building of roads and canals, even the building of railroads, was done by the military. There was little need for the services of mechanical engineers, and there was absolutely none for electrical or chemical engineers.

As our population grew and the nation expanded westward, it became evident that the complexities of civilization were becoming too great for the military engineers to handle, and so, by virtue of necessity, there came into being, more and more, non-military or *civil* engineers. By 1852 there was a sufficiently large number of such non-military engineers to warrant the formation of an engineering society for the purpose of interchanging ideas, knowledge and experience, and so in that year the American Society of Civil Engineers was founded. This year then, 1952, marks the 100th anniversary, not of the ASCE alone, but of the date engineering was recognized as a profession in the United States.

Why the Centennial?

The real purpose of the celebration in Chicago this year, however, is to remind our fellow Americans of the factors that have produced our prosperity and the contributions which scientists and engineers have made to it. The theme which will carry through its many activities will be based on the fact that, with six per cent of the world's land area and less than seven per cent of the world's population, we in America produce, own, and use nearly 50 per cent of the



world's goods. We own 72 per cent of all automobiles, 60 per cent of the telephones, 90 per cent of the television sets, 50 per cent of the radios, and 34 per cent of the railroads. We use 56 per cent of all the silk, 53 per cent of the coffee, and 51 per cent of the rubber. We produce 62 per cent of all the oil, 53 per cent of the corn, 50 per cent of the cotton, 34 per cent of the coal, 32 per cent of the copper, and 30 per cent of the iron.

While engineers are reasonably well aware of the part engineering has played in bringing about our high scientific and industrial development, the general public is not. The average person gives the matter little thought. Most of us take our scientific civilization for granted and give little thought to the social implications of many of the complex devices we use and produce. Even engineers are likely to forget or overlook the significance of the machines they produce. Consider, for example, the electric starter. Few of us, when we turn the switch on the dashboard of our cars, ever think of the importance of the comparatively simple combination of storage battery and electric motor which cranks our engine. Yet, this starter has resulted in a great change in our way of living — it has made it possible for women to drive cars. As Dr. James Morrill, President of the University of Minnesota, pointed out recently, this may not be an unmixed blessing but no one will deny its influence in our lives.

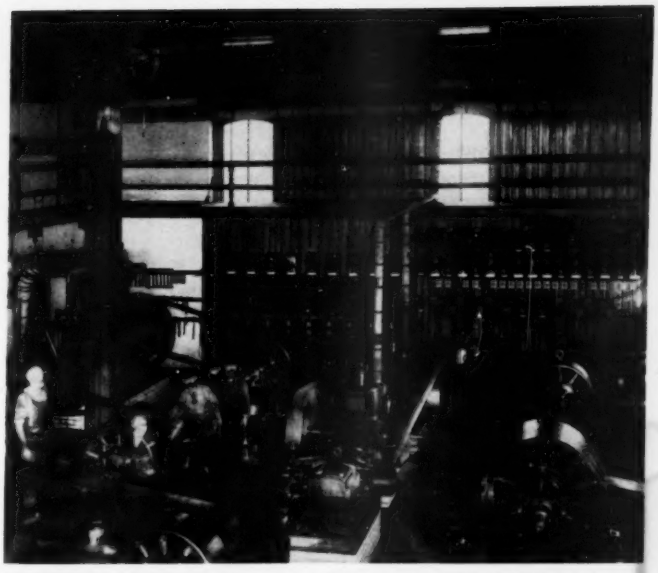


Fig. 1. The tremendous advance in the generation of electric power during the last 64 years is shown in the difference between the picture of this generating station taken in 1888, and the picture of the 100,000 kw generating units at Sewaren Station shown in Fig. 2 on page 69, with a great many times the capacity

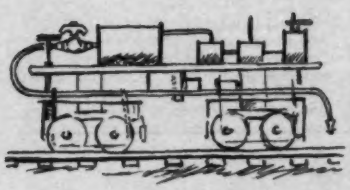
Influence of Engineering

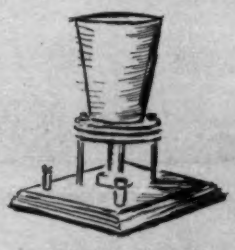
The Centennial celebration, with the active participation of engineers all over the country, presents an opportunity to stress the ingredients which have produced our material wealth not only to our contemporaries, but, what is particularly important, to the younger generation which is still in the formative stage. For they will determine the social, political, and economic trends of the future; they will build the structures on the foundations which we have laid. Recent surveys among high school students have shown alarming misconceptions of the fundamentals of our industrial structure and the environment of freedom that nurtured it for so many years.

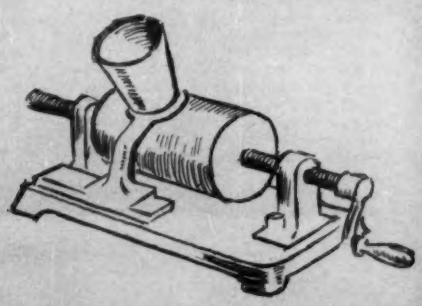
They question whether the course we have pursued for the last hundred and fifty years was the best or the only one. Carl Sandburg said, "No nation ever falls, never to rise again, unless it forgets where its national greatness came from." We must demonstrate that a national career which has been so eminently successful does not warrant experiment with untried forms of national economy.

This younger generation feels no responsibility to tradition. They have a heritage of change, development, and progress, and they wish to contribute their share to this evolutionary process. Their bright minds ask pertinent questions: How important are the material things which our high standard of living has given us? Has it produced spiritual values and philosophical concepts such as those of Christianity, freedom, democracy, and equality among men, better than those developed under lower and alien standards of living?

Those of us who can remember the early years of this century are more likely to understand the significance of the part the engineer has played in our modern world than the young people of today because we can remember, for example, the days when automobiles did not have self starters. To the young people of today, the electric light, the refrigerator, the radio, the sewing machine are commonplace necessities. An automobile is not a contraption to scare horses, but an ordinary unit of transportation. The roads that the automobiles travel on are not marvels of engineering, but just highway numbers running from one point to another. The Dacron dress, the Nylon stockings, the plastic leather handbags, the Vynilite rain coat, are not triumphs of the chemical engineer; they are only necessities, accepted as part of every-







day life. Even the marvel of television has ceased to be the magic thing it was only a few years ago, and is accepted almost as casually as the toaster and the vacuum cleaner.

It is not to be expected that we should go about from day to day in utter amazement at the performance of these gadgets of civilization but it would be better for all of us if the general public had a better appreciation of the engineer's part in their development, performance and application. At the present time, for example, there is a critical shortage of engineering manpower. It is therefore necessary to revitalize interest in engineering both in the youth of this country and also the parents, so that the young people will be given proper encouragement when the time comes for them to choose a career. Also, if there was greater general knowledge concerning the significance of technology upon society, we might better be able to cope with countless irritating problems which set peoples apart.

The Growth of the Use of Power

Very few people in the world, for example, have any real conception of the influence the use of thermal and mechanical energy has had, and has, upon human welfare. While the physical aspects of power generation and use are comparatively simple, its effects on the social, cultural, economic, and political organization of mankind is complex and difficult to trace. On the physical side, the facts of equipment and method are easily ascertained and classified. Certain natural laws have been discovered and applied and the effects due to this scientific progress can be traced. But man's reactions are complex and the endeavor to analyze the effect of technological progress on his life and welfare is complicated by sociological and economic theories and assumptions.

Before the machine age, man's tools — wedge, screw, lever, wheel and spring — were associated with muscular energy. The notable exception was the use of wind power to replace man's power primarily for boat propulsion. This had a tremendous effect on standards of living and distribution of population. By its use the Phoenicians rose to a dominant place in the world trade: trade expanded, human relations diversified, the Americas became a part of world economy. Then came the mastery of expanding gases. First gunpowder to force a projectile (piston) to a distance; next the attachment of a rod to the piston to convert linear into rotary motion; then the application of vapors and explosive fuel to driving the pistons.

All this took much time and experiment but, in its development lay the foundation of the machine age. Previously, even in the use of water power, man mastered only small amounts of energy. But with the use of steam and combustion engines, he became vigorously aggressive in his attack on Nature's storehouses, which soon brought about fundamental changes in his pattern of living. Large amounts of power were developed but were very localized. Congested centers for use of power resulted, with new division of social and economic groups whose interests became diverse rather than common as they were when agriculture was the predominant human activity.

Later, with the discovery of electromagnetic induction, the conversion of mechanical energy into electrical energy became possible and the art of electric transmission developed. This brought about another change in the social and economic structure; decentralization became possible, and our use of power increased enormously. Paralleling the development of electrical distribution came the development of the internal combustion engine giving wide availability of small amounts of power and great mobility. This further raised the standard of living and increased the range of human desires.

Thus, it is seen that all developments in technology are intimately and inexorably intertwined with human desires and aspirations and an intelligent understanding of our culture demands a much more than passing knowledge of engineering processes and developments on the part of mankind in general.

Organization of the Centennial

The Centennial of Engineering being held in Chicago this year attempts to impart this type of information to the public. This is being accomplished in three principal ways:

1. By means of a special engineering exhibit which is carefully inte-

SYMPOSIA SUBJECTS AND CHAIRMEN

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Chairman of Board
General Foods Corporation

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Kenneth M. Codit,
Dean, School of Engineering
Princeton University

STRUCTURES AND CONSTRUCTION
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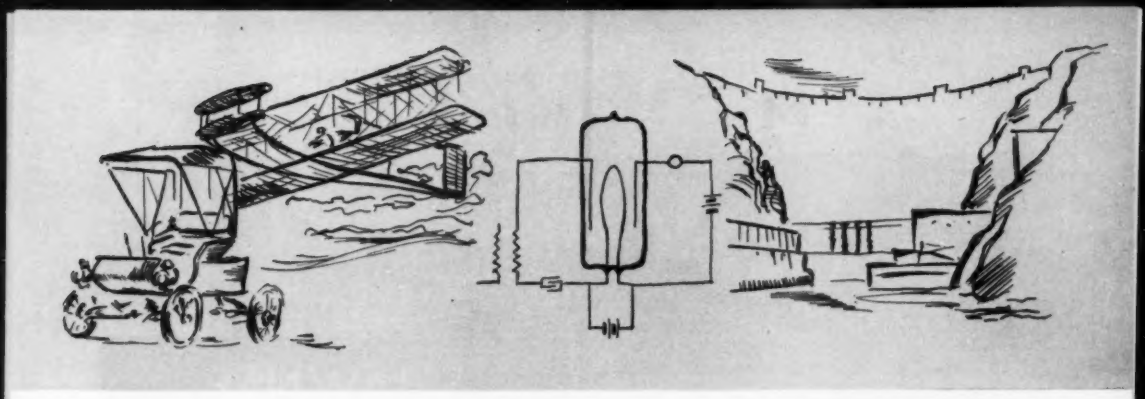


grated with the other prominent exhibits now located at the Museum of Science and Industry.

2. By means of a stage production depicting engineering advancement.

3. By an international convocation of engineers of all kinds. In addition, a special commemorative stamp is being issued and a motion picture is to be released for use the country over.

Exhibits to be Dynamic

The special section at the Museum of Science and Industry is devoted exclusively to special, dynamic exhibits of an engineering nature. There are nine elaborate displays ranging all the way from aluminum to lubrication. All of these have a special appeal to the general public, but at the same time are of great interest to the most critical engineer. One such exhibit, that of the Cincinnati Milling Machine Company, for example, explains the six basic types of machine tools, how they are used in factories, and the size, accuracy, and amount of finished product each can produce. This display shows how the centerless grinder mass produces such items as bowling and billiard balls, and even suture needles for the medical profession. At another part of this exhibit the manufacture of such a simple item as an ashtray is demonstrated. Starting with the artist's conception, the blueprints of the device, the making of the wooden die mold, the rough and then the finished steel die, and finally the stamping process, are all clearly reproduced.

The second phase of the Centennial is the stage production *Adam to Atom* shown twice daily in the thousand-seat theatre in the Museum of Science and Industry building. This production rivals in artistry and audience interest the best plays of Broadway. It tells the story of man's progress and the role of the engineer and scientist in this advance. In interest it exceeds the record-breaking *Wheels A Rolling* at the Railroad Fair two years ago. The curtain opens on a scene showing atomic scientists and engineers working on a complicated nuclear experiment. This scene portrays man's engineering triumphs at the present time. The next scene flashes back to the days of the cave man, showing how he spent all his waking hours searching and fighting for the bare necessities. Suddenly, one of the cave men discovers that fire can be controlled. This is the first great step forward in man's progress for a better life.

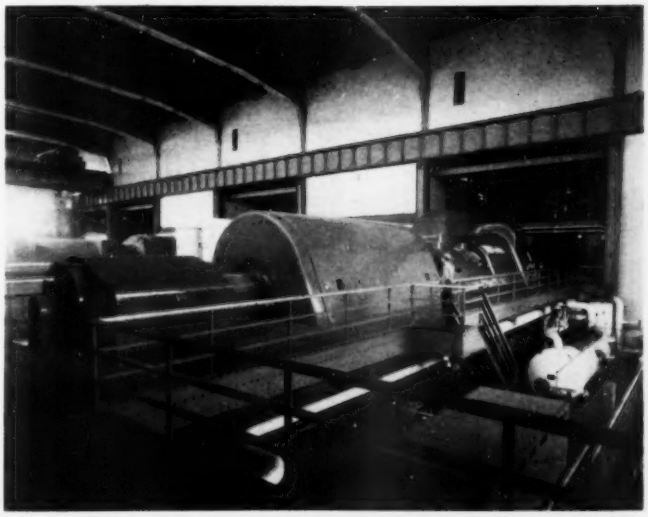
There are a series of authentic scenes showing the human interest story behind Eli Whitney's inventions, Alexander Graham Bell's telephone, Morse's telegraph, Edison's triumphs, and other major discoveries which have contributed so much to our progress. Gutenburg's invention of the printing press and the subsequent advance of learning is dramatically and colorfully unfolded. Other scenes depict the great Columbian Exposition, the building of the Panama Canal, Ford's mass production concept, and the story of rubber. This show is pure entertainment, something that all members of the family can enjoy. Subtly woven into the background is the message of man's progress through engineering.

The third aspect of the Centennial of Engineering is the convocation of engineers which will be held between September 3 and 13. This will probably be the most important part of the program for the engineer. During those ten days some 51 engineering societies and associations will hold full scale national technical meetings.

Symposia on General Subjects

In addition to the normal technical meetings of the individual societies, there will be symposia on the general subjects of food, tools, structures and construction, transportation, mineral industries, chemical industries, communications, energy, urbanization, health, education and training, and professional societies. Although technical in nature, these symposia will be presented in general terms so as to be understandable by those who are not experts in the specific fields. The comments of a well qualified individual outside the specific engineering field will be presented.

Fig. 2. A 100,000-kw single shaft generating unit at Sewaren Station. This station has a heat rate of 10,389 Btu per kwh. The 1888 plant shown in Fig. 1 probably had a heat rate four or five times greater



SHAWNEE

TVA to AEC

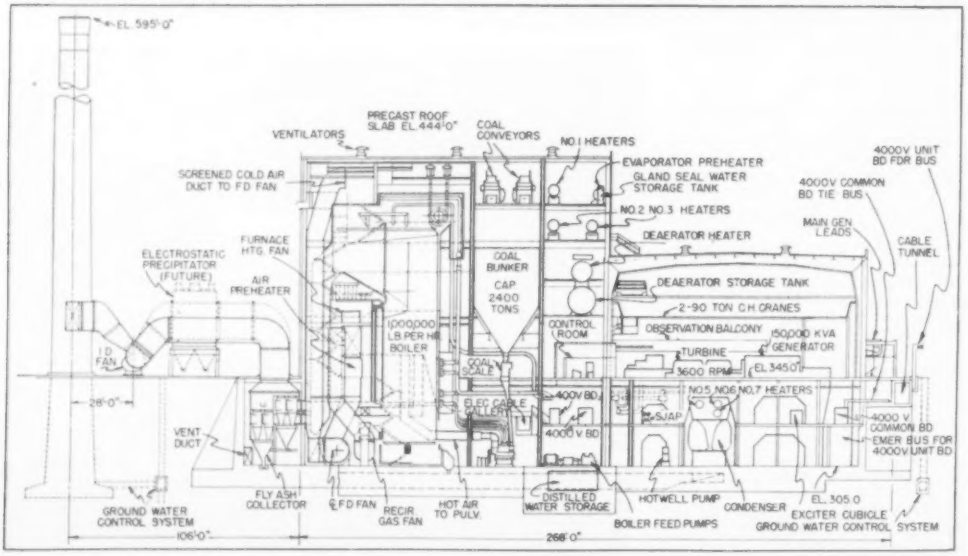
Sharing the AEC's Paducah load with Joppa, TVA's Shawnee steam plant is laid out for an ultimate 1,500,000 kw in ten units. First 150,000-kw unit will go on the line early in 1953. Design heat rate is 9303 Btu per kwh

By H. J. PETERSEN
Head Mechanical Engineer
and Chief of Mechanical Design Branch
Tennessee Valley Authority

WHEN THE Atomic Energy Commission decided to construct an atomic energy plant near Paducah, Ky., in the fall of 1950, provision for a large block of power at that site became necessary. This need was finally resolved by splitting the required power load equally between a group of private utilities under the name of Electric Energy, Inc., and the TVA. Shawnee Steam Plant, located about 10 miles west of Paducah on the south bank of the Ohio River, will provide the TVA portion of this load and the Joppa Plant, a few miles farther down the river and on the north bank, is to provide power for EEI.

Congress authorized funds for Shawnee on January 6, 1951, and construction started the same day. The site is laid out for an ultimate of 10 units. Four units have been authorized, with the first unit to go on the line about January 1, 1953. Estimated cost for the first four units is $88,500,000 — a cost of $147.50 per kw of capacity. This figure will be reduced somewhat as additional units are installed, because the site area

Fig. 1. Powerhouse cross-section shows arrangement of equipment for first four of 10 units. Basic design differs from Johnsonville and Widows Creek plants



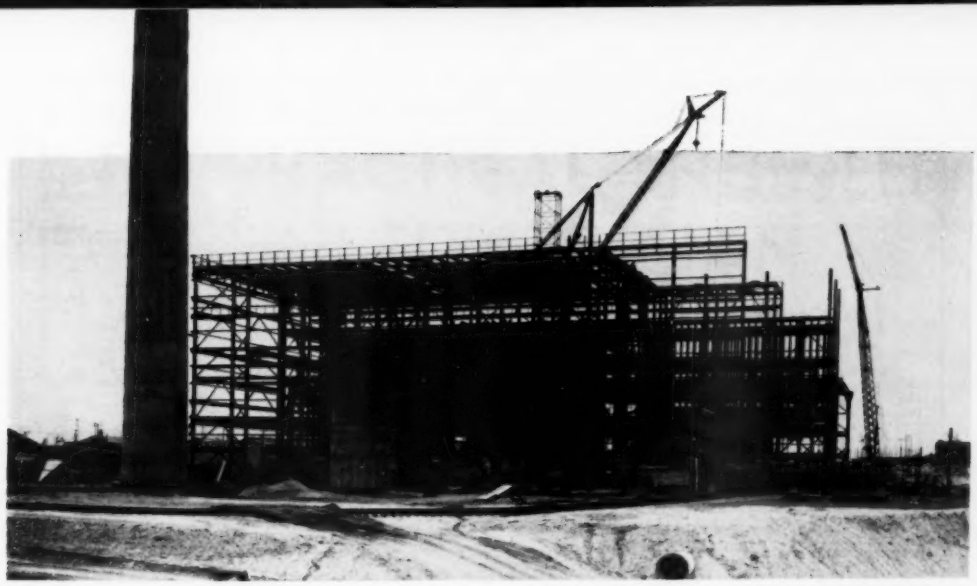


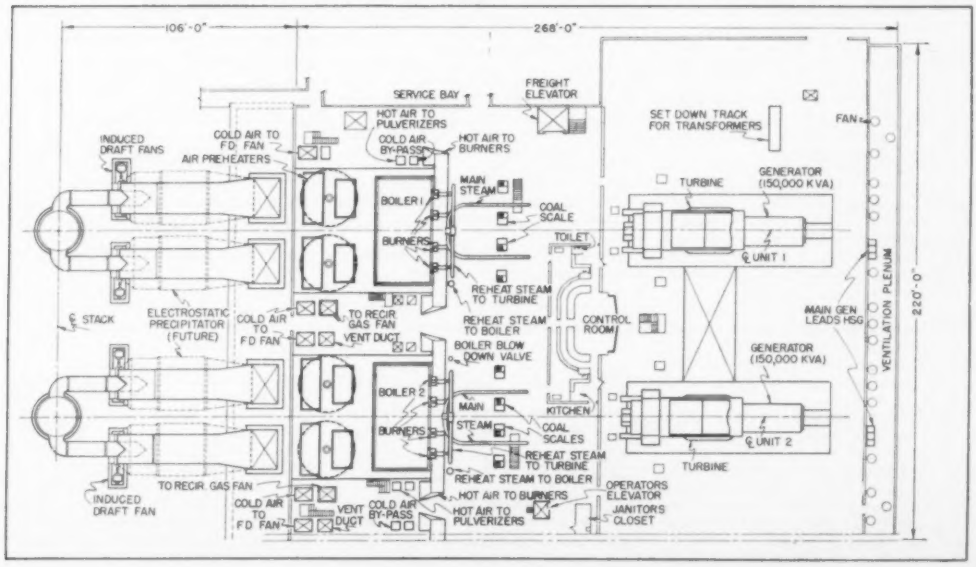
Fig. 2. View of powerhouse structural steel from top of intake structure, with stack No. 1 at left. Stacks 2, 3 and 4 will be the same as this and will be adjacent

and a good many of the features such as coal handling and water supply have been purchased and installed for more than four units.

Earthquake Design: — The site is in an area subject to seismic disturbances and for this reason the powerhouse steel is designed to withstand an earthquake force of 0.1 g (g = gravitational force = 32.2 ft per sec per sec). Similar provisions were made in the design of concrete basement walls. Basic design of the powerhouse also was changed from that used at our first two plants (Johnsonville and Widows Creek) in order to minimize earthquake stresses. Location of the mechanical draft fans, fly-ash collectors, air preheaters, and attendant ductwork was changed from a position above the boiler where they are on previous plants to various points below. This was accomplished by using a downdraft boiler and putting induced draft fans on grade level outside the plant where they discharge into 250-ft-high concrete stacks. This arrangement is shown in Fig. 1.

Design for Uplift: — River elevations range from a low of 288 ft above sea level to a flood height of 345 ft. Basement floor of the plant is at elevation 305 ft. At Johnsonville uplift was taken care of by concrete anchor piles extending into the foundation chert, and at Widows Creek uplift was compensated for by grouting 1¼-in. square steel dowels into the rock formation. However, Shawnee rests on gravel so neither of the above schemes for counterbalancing uplift would work.

Fig. 3. Floor plan of units 1 & 2 shows unit system — one boiler per turbine. One control room serves both units. Units 3 & 4 are similar and will be adjacent



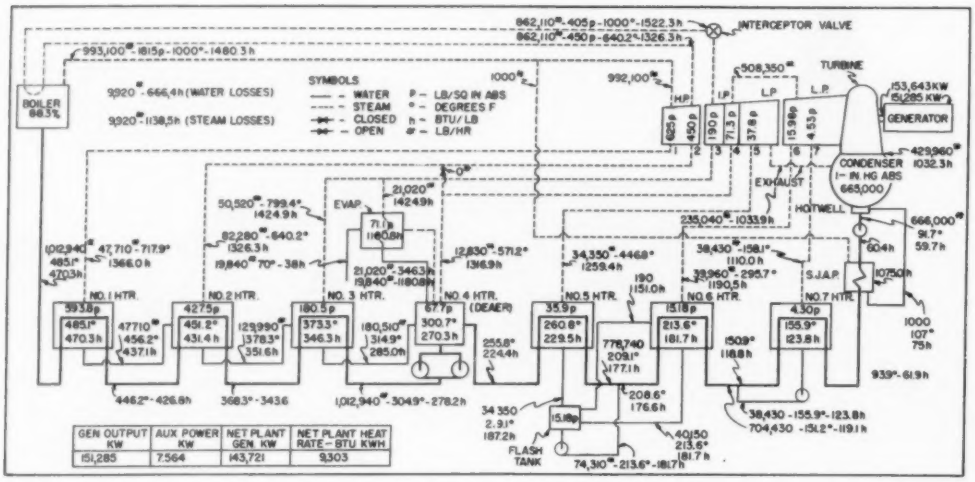


Fig. 4. Heat balance diagram which shows seven stages of feedwater heating which will be used for first four units. Plant heat rate will be 9303 Btu per kwh

Criterion elevation for uplift is 330 ft, which is exceeded only at rare intervals. A drainage system was designed which will automatically keep water level below this figure. This system consists of a layout of drainage pipes around the plant from which four pumps with a total capacity of approximately 12,000 gpm draw ground water. The pumps start in echelon between elevations 325 and 327 ft, and all pump until elevation 318 ft is reached, when they all stop.

Condenser Circulating Water Chlorinating System: — Character of water of the Tennessee River on which both Johnsonville and Widows Creek Plants are located makes it unnecessary to chlorinate the condenser circulating water at those plants. However, our investigations showed that the mixture of Tennessee and Ohio River waters obtained at Shawnee would require such treatment, and consequently, a chlorinating system was installed.

Two automatically controlled vacuum-type chlorinators each having a maximum capacity of 6000 lb per day are provided. Water will be dosed intermittently by program control in which dosage, time of dose, and time between doses can be varied to produce optimum chlorine residual in the condensers for water being handled. Chlorine enters the system at the suction of the circulating pumps. The system is designed to take chlorine either from tank cars or 1-ton containers.

Turbine Generators: — The unit system of one boiler per turbine is employed, as shown in the floor plan, Fig. 3. Turbine generators are rated 135,000 kw at 0.9 pf, 0.5-lb hydrogen pressure, with a 150,000-kw capacity. They are TCTF 3600-rpm machines, 1800 psi, 1000 F reheat to 1000 F. Generators are 18,000 v with a 15-lb hydrogen rating of 168,539 kva, and a 30-lb hydrogen rating of 176,470 kva.

Steam Generating Units: — Steam generating units are completely water-walled, dry-bottom type, and have a continuous rating of 1,000,000 lb per hr each, with steam conditions at the superheater outlet of 1825 psi and 1003 F. These units have a 4-hr capacity of 1,100,000 lb per hr. Reheater flow is 870,000 lb per hr at 1003 F.

Furnaces are of the radiant type with outlet temperatures controlled by spray water and recirculation of gases. Total heat input to each furnace at rating is 1,340 m&B per hr. They are designed to burn pulverized West Kentucky and Southern Illinois coal having an ash softening temperature of 1950 F.

Exit gas temperatures from the air preheater have been limited to a minimum of 306 F at rating (uncorrected) to minimize fouling of the air heater at part-load operation. However, provision has been made in the

(Continued on page 106)

LIST OF PRINCIPAL EQUIPMENT AT SHAWNEE STEAM PLANT

Boiler Equipment

Steam Generators....Babcock and Wilcox Co.
Soot Blowers and Utiliscopes....Diamond Power Specialty Corp.
Boiler Feed Pumps....Ingersoll-Rand Co.
Combustion Controls....Republic Flow Meters Co.
Piping....Benjamin F. Shaw Co.
Ash-handling System....United Conveyor Corp.
Draft Fans....American Blower Corp.
Fly-ash Collectors....Buell Engineering Co., Inc.
Coal Scales....Richardson Scale Co.
Coal Valves....Columbus Conveyor Co.
Air Compressors....Pennsylvania Pump and Compressor Co.
Control Air Compressors....Worthington Corp.
High Pressure Valves....Chapman Valve Manufacturing Co.
Safety Valves....Consolidated Safety Valve Div., Manning, Maxwell and Moore, Inc.
Butterfly Valves....Henry Pratt Co., Inc.
Coal-handling Equipment....Link-Belt Co.
Stacks, Concrete....Custodis Construction Co., Inc.
Breechings, Ductwork....Connery Construction Co.

Electric Equipment

Control Boards....Republic Flow Meters Co.
Main Transformers....General Electric Co.
Main Switchboard....Allis-Chalmers Mfg Co.
Auxiliary Switchboard....I.T.E. Circuit Breaker Co., Westinghouse Electric Corp., Northeastern Engineering, Inc.
Station Service Transformers....General Electric Co., Westinghouse Electric Corp.
Oil Circuit Breakers....Westinghouse Electric Corp.
Intercommunication System....Taylor Electric Co.
Auxiliary Motors for Fans & Pumps....Allis-Chalmers; Elliott; General Electric; Westinghouse; Fairbanks, Morse

Turbine-Generator Equipment

Turbine Generators....Westinghouse Electric Corp.
Condensers....Foster Wheeler Corp.
Feedwater Heaters....Lummus Co.
Deaerating Heaters....Cochrane Co.
Evaporators....Lummus Co.
Circulating Water Pumps....Worthington Corp.
Condenser Water Conduits....Lock Joint Pipe Co.

Water-Treating Equipment

Zeolite Softeners....Hungerford and Terry, Inc.
Condenser Chlorinating.....Wallace and Tiernan, Inc.
Secondary Chemical Feed.....Proportioneers Inc.
Traveling Water Screens....Link-Belt Co.

Other Equipment

Turbine Room Cranes....Cyclops Iron Works
Powerhouse Structural Steel....American Bridge Div United States Steel Co.
Aluminum Siding....H. H. Robertson Co.
Roof Decking....H. H. Robertson Co.
Steam Traps (h-p) and Water Columns....Yarnall-Waring Co.
Steam Traps....Armstrong Machine Works
Boiler Blow-off Valves....Yarnall-Waring Co.
Insulation....Badham Insulation Co. Includes materials by Ehret, Eagle-Picher, Arabol, Badham, Newark Hairfelt.

DON'T CLIP THIS ARTICLE

Others in your plant may want to read the complete issue, so if you want an extra copy of this or any other article, ask the Editor for tear sheets or a reprint. For convenience, use the postage-free card that you will find elsewhere in this issue.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

The Hard Way

ELSEWHERE in this issue you will read about the Centennial of Engineering now being celebrated in Chicago. In that account you will see a photograph of a typical power plant of the 1880's and another of one of the newest and most economical power plants of 1952.

But in celebrating our skill in developing the power plant from the 1880 model to 1952's magnificent stature, with promise of still greater progress to come, the celebrators do not forget one of the most vital links in the chain of development—the men who operated the equipment.

Many of the power engineers celebrating the Centennial today came up the hard way themselves—the greasy overalls, the wrenches and cold-chisels, the 7-day week and the 12-hr shift (and even 13-hr shifts in paper mills—remember?) Many of these men cut their engineering eye-teeth on equipment that required constant watching, a tremendous amount of operating skill, an amount of physical labor that is unheard of today. But, by the Eternal! they learned power engineering!

Their fellow engineers should be proud of them—and are. For without them, combined with the skill and brains and determination of consulting engineers, designers, inventors, manufacturers and sales engineers, plus some farsightedness on the part of power plant management, we would not be celebrating a Centennial of Engineering today.

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Definitely Yes, Says Tatman
Wintersteen Claims Money a Factor
Eventually, Says Schieck
Yes, Even with Salt Water, Says Trncak
Yes, But Foot Valve Will Help, Says Cochrane

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Fig. 1. Suspended fluorescent lighting is used with the Fiberglas acoustical ceiling board in the chemistry laboratory of the Acme Power Plant of the Toledo Edison Company, Toledo, Ohio

Fig. 2. When break-downs occur in the Toledo Edison power system these men in the load dispatcher's office restore light and power as quickly as possible by redistributing the power from various sources

Acme Installs Acoustical Ceilings . . .

WHAT WAS ONCE an abandoned sub-station at the Acme Power Plant of the Toledo Edison Company is gradually becoming an attractive office and service building.

The structure, unused for several years because of declining use of 25-cycle power, is being utilized to fit company expansion plans for the future.

Three new rooms have been built in the spacious building through the use of cinder blocks, asphalt tile and non-combustible Fiberglas acoustical ceiling board.

The three new rooms include a load dispatcher's office, shown in Fig. 2, a chemical laboratory shown in Fig. 1, and an assembly room. Other rooms are now in the drawing board stage.

Fiberglas acoustical ceiling board, 4986 sq ft of it, was chosen for the three new rooms mainly because of speed and economy of installation.

Alumi-Coustic system of installation was used. This system consists of $\frac{1}{2}$ in. furring channels, 4 ft on center, to which rolled aluminum T-sections with one inch bottom flanges are fastened at right angles by means of special clips. The clips hold the T-sections rigidly in place, so that no lateral bracing is required.

The ceiling board is $\frac{3}{4}$ in. thick, fabricated to a nominal $23\frac{3}{4}$ by $47\frac{3}{4}$ in. size to fit in 24- by 48-in. grid spacing. The board is factory sanded and painted with one coat of white, non-bridging paint.

These suspended ceilings in the Acme Power Plant building, besides being economical to install, have resulted in reduced heating costs since they shut off the vast space above.

Accessibility is provided because the boards can be easily lifted from the grid for maintenance or emergency reasons in the area above. The boards may be cleaned in position or removed. They may be cleaned with a vacuum cleaner, wallpaper cleaner or spray painted with any good water-base paint. This treatment does not decrease the acoustical value.

Two other important features of acoustical ceiling board are its high light reflection and non-combustibility.

The ceilings were installed by Turner-Brooks of Toledo. The A. Bentley and Sons Co. was the contractor.

This type of ceiling and lighting could be easily and economically installed practically anywhere else in the power station.

Fig. 3. The center supporting rib is used as a guide for the other ribs and is carefully cut and leveled

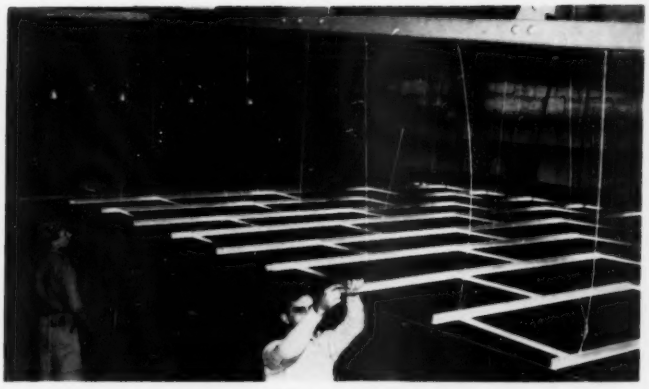


Fig. 4. The grid system is periodically checked for level with a chalk line to assure a good workmanlike job

Fig. 5. A job die, made by Cupples Corp. is used for exact cutting and forming of supporting and cross ribs

Fig. 6. Splice plates are installed on ground or after rib is in place. Pliers squeeze ears flat

. . . Here's How They Did It

Fig. 7. Fabricated ends of the 24-in. cross ribs are inserted through small slots in the main supporting ribs and given a slight twist with a pair of pliers

Fig. 8. Wall angle is installed around perimeter of room on a chalk line established by use of a water level. Wire is straightened by twisting under tension

Water Treatment Engineering—
What Is Scale?

By L. W. FITZPATRICK
Chief Engineer
Department of Corrections,
State of Missouri

This is the second in a series of articles devoted to practical descriptions and explanations of how water is handled and treated in the power plant. The first article discussed the impurity of water. This one examines scale and various scale formations

ALL WATERS when evaporated to steam leave behind residual mineral matter. These deposits are basically identical whether referred to as scale or sludge. Scale is an adherent deposit on the water side of the boiler heating surface. Loose circulatory formations are termed sludge.

Scale and or sludge conceivably form in the following manner: 1. Decomposition of soluble compounds to less soluble compounds; 2. Precipitation of compounds whose solubilities decrease with temperature rise; and 3. Precipitation of compounds with solubilities such that boiler water concentrations become supersaturated.

Water composition and concentration naturally will vary the density, adherence and porosity of scale formations. Calcium and magnesium carbonates form soft and chalky scale. Calcium sulfate forms adherent hard scale.

Calcium Salts

Hot water, free of carbon dixoide, will hold 17 ppm of calcium carbonate. Cold water, containing carbon dioxide, will dissolve approximately 906 ppm of calcium carbonate, which then becomes calcium bicarbonate. In the heated boiler, when the carbon dioxide departs with steam, calcium bicarbonate is decomposed to calcium carbonate. Therefore, it is apparent that any excess (over 17 ppm) calcium carbonate will precipitate when steam is produced. Heat, of course, is responsible for the reaction.

With low alkalinity calcium carbonate scale is very sticky and adherent. It usually is deposited in cooler parts of the boiler rather than in tubes, and its sludge is readily removed by blowdown.

Calcium carbonate will form from calcium as well as other carbonates such as sodium bicarbonate (reverting to sodium carbonate), if other chemically active calcium salts are present in the boiler water.

Calcium sulfate is another matter. While calcium sulfate has a solubility of 1290 ppm in 32 F water, its solubility drops sharply to about 34 ppm at 360 F. Modern methods of chemical treatment precipitate calcium salts in some form other than calcium sulfate. A scale with quantities of calcium sulfate in it shows that water treatment is inadequate or improperly applied.

Because silica is present in all raw waters, higher concentrations are easily picked up from sand filters, zeolite and other type softener gravel beds. Calcium and silica scale combines to form calcium silicate — a scale which is glassy, extremely hard and possesses excellent heat insulation qualities.

Silica and Magnesium

Sodium-aluminum silicate forms rapidly in boiler waters of low alkalinity. Analcite scale requires considerable amounts of aluminum and is characteristic to a high pressure operation. Neither scale forms with calcium or magnesium, and, therefore, will generally be found in low-hardness boiler waters. Proper treatment of feedwater requires that silica and aluminum ion concentrations be held to a minimum.

Magnesium does not form sulfate or carbonate scales similar to those of calcium. Magnesium bicarbonate decomposes under heat to form magnesium hydroxide, because the hydroxide is much less soluble than the carbonate. If enough silica is present in the water, magnesium hydroxide combines and precipitates out as magnesium silicate, also slightly soluble.

Magnesium hydroxide often forms a sticky sludge inside boilers. Magnesium silicate can form as a sludge which is readily removed by blowdown.

Table I

Relative solubilities of the common chemical compounds found in most boiler feedwater and drumwater

Solubilities of Calcium, Magnesium and Sodium Bicarbonates, Carbonates, Chlorides, Hydroxides and Sulfates					
Chemical Compound	Formula	Ppm of $CaCO_3$ at 32 F	Ppm of $CaCO_3$ at 212 F	* Gpg of $CaCO_3$ at 32 F	* Gpg of $CaCO_3$ at 212 F
Calcium					
Bicarbonate	$Ca(HCO_3)_2$	1,620	decomposes	94.5	decomposes
Carbonate	$CaCO_3$	15	13	0.9	0.8
Chloride	$CaCl_2$	336,000	554,000	19,600	32,300
Hydroxide	$Ca(OH)_2$	2,390	888	139	51.8
Sulfate	$CaSO_4$	1,290	1,250	75.3	72.9
Magnesium					
Bicarbonate	$Mg(HCO_3)_2$	37,100	decomposes	2,170	decomposes
Carbonate	$MgCO_3$	101	75	5.9	4.4
Chloride	$MgCl_2$	362,000	443,000	21,100	25,900
Hydroxide	$Mg(OH)_2$	17	8	1	0.5
Sulfate	$MgSO_4$	170,000	356,000	9,920	20,900
Sodium					
Bicarbonate	$NaHCO_3$	38,700	decomposes	2,260	decomposes
Carbonate	Na_2CO_3	61,400	290,000	3,580	16,900
Chloride	NaCl	225,000	243,000	13,100	14,200
Hydroxide	NaOH	370,000	970,000	14,200	56,900
Sulfate	Na_2SO_4	33,400	210,000	1,970	12,300

Table II

Simple chloride and sulfate relationships can be employed as a yardstick to sulfate scale formation

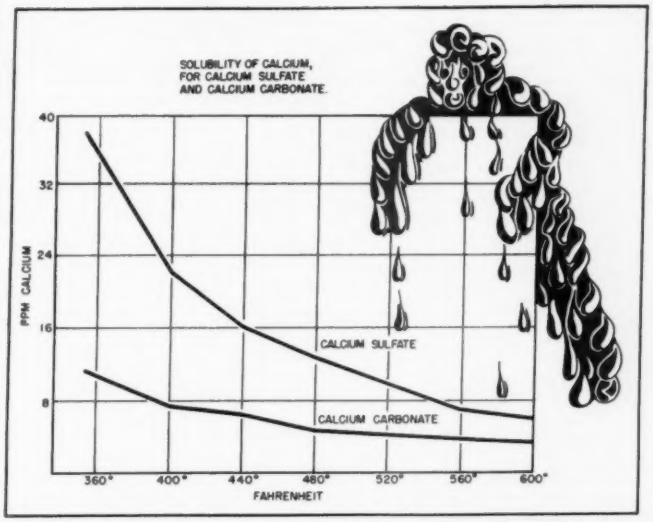
Control Test For Scale	
Feedwater = C_f (chlorides) and S_f (sulfates) Boiler water = C_b (chlorides) and S_b (sulfates)	
Formula 1 S_b EQUALS C_b / S_f C_f	No sulfate scale depositing
Formula 2 S_b GREATER C_b / S_f THAN C_f	Sulfate scale being removed
Formula 3 S_b LESS C_b / S_f THAN C_f	Sulfate scale forming. Hardness present in boiler water

Table I shows the relative solubilities of common chemical compounds usually found in all boiler feed and drum waters. However, the presence of all salts dissolved in boiler water solutions appreciably affects the solubilities as shown. Sodium salts, especially, lower calcium sulfate solubilities.

Sodium salts being extremely soluble in either cold or hot water do not form scale unless evaporation is carried out to mildly saturated ends.

Factors Affecting Scale

Boiler scale formation is always a function of the rate of decrease in solubility of compounds to temperature increase. A contributing factor is the rate of heat transfer across the surface on which scale is forming. Boiler water velocity has a slight influence. Naturally, scale is decidedly more serious in a watertube boiler than in a hrt-type fire tube boiler. A scale 1/16-in. thick invariably means trouble in water tubes exposed to radiant heat, whereas heavier deposits on fire tubes mean loss of efficiency but may not be dangerous.



Solubility of calcium for calcium sulfate and calcium carbonate drops sharply as temperature increase

Your Operating Practices Can Cut Your Maintenance

By F. L. BRADLEY

Forstmann Woolen Co., Passaic, N. J.

How are your operating practices? Are you meeting production demands? Do you have a good, active, personnel training program? What kind of maintenance crew do you have? Here are the answers to these important questions and others

YOUR MAINTENANCE budget can be raised or lowered by your operating practices. It is a well known fact that excess fan capacity is a means of securing cheap boiler capacity. You have seen stokers and boiler settings take terrific abuse from attempts to get maximum steam rates based on this premise. A well-stocked supply of tuyeres and refractory shapes will help these fans in the process of accelerated depreciation on the steam generator.

In some plants, production demands impose this type operation on the station chief. They do not limit him, however, in tapping the full maintenance potentialities of a well-trained operating crew. These men can make or break your maintenance budget. We all recognize the truth of this statement, but what do we do about it?

You are indeed fortunate if each of the Chief Power Engineers responsible for your plants are really alive to these possibilities. To these men goes the credit for so educating the crews that these operators would be greatly concerned if any situation got out of hand to such an extent as to require major repairs. This concern of the men is more important than schedules and routines. The value of these latter items is reduced unless the men are interested and take pride in their work. For instance, there are bearings in every plant for which scheduled lubrication is not enough. Close watch is necessary to avoid failure. The operators responsible for them should acquire such an interest in them that if anything goes wrong, the men feel it is a personal affront to their watchfulness and ability.

To secure crews with this viewpoint, men should be selected carefully with respect to intelligence and previous experience. Promotions should be made from within the power plant organization. Examine each new hire at the bottom of the list for his potentialities of becoming a future Chief Power Engineer. During normal breaking in under the watchful eye of the shift foreman, the new man should have for his guidance an operating and equipment manual. This manual tells him not only how to operate the equipment, but also what to expect from it. A formal course of instruction in power plant operation should be made available periodically to the men who want it. The supervisory staff should act as instructors and the double-barrelled advantages of extra thorough review of operating and maintenance considerations often develop new and improved maintenance procedures.

You will find if you do this that it has an important bearing on your over-all maintenance program. It is comparatively easy to hire competent men to repair practically anything that breaks down. However, it is fundamentally necessary to impart to them a true understanding of the real reason for their employment. Also, they should understand and carry out the basic principles of preventive maintenance.

The organization for maintenance must be tailored to the requirements

PART TO BE SERVICED	DISTRIBUTION SYSTEM				GEAR BOX				DRIVE SHAFT				MOTOR				FILLING				COLD WATER BASIN				STRUCTURAL MEMBERS			
FREQUENCY	W	S	Y	R	W	S	Y	R	W	S	Y	R	W	S	Y	R	W	S	Y	R	W	S	Y	R	W	S	Y	R
INSPECT FOR CLOGGING	X																	X			X							
CHECK FOR UNUSUAL NOISE OR VIBRATION					X				X				X													X		
FEEL FOR OVERHEATING													X															
CHECK SHAFTS FOR LATERAL MOVEMENT					X								X															
INSPECT KEYS AND KEYWAY					X								X															
CHECK OIL LEVEL AND OIL FOR WATER AND DIRT					X								X															
MAKE CERTAIN VENTS ARE OPEN					X								X															
INSPECT FOR DETERIORATION																		X					X			X		
LUBRICATE				X		X			X							X												
TIGHTEN LOOSE BOLTS				X		X			X																			
REPAINT								X				X				X								X				X
DRY OUT															X													
CLEAN				X															X					X				
RENAIL (IF NECESSARY)																		X										

W-WEEKLY : S-SEMI-YEARLY : Y-YEARLY : R-AS REQUIRED

Fig. 1. A sample maintenance schedule which was used for a cooling tower. It can be used as a master schedule or road map to show where you are headed

of the individual plant. In some plants the operators do all the maintenance work except that requiring skilled machinists and heavy machine tool equipment. Some plants have a separate maintenance crew within the power plant, complete with necessary machine tools. You can make effective use of a combination of these methods.

One plant normally operates with a foreman and three operators. Each is assigned to and responsible for the condition of a specific operating area and specified equipment. A relief foreman and a relief operator can function normally three days a week in the relief role and three days on maintenance. This relief pair will augment the maintenance efforts of the operating crew. While the value of such training in upkeep and repair depends on the man, it pays off well in development of the right kind of operator and upkeep of equipment.

A maintenance schedule, such as shown in Fig. 1 which is for a cooling tower, is usable for each equipment unit. It can be used as a road map to show where you are headed. The master schedule covering other routine repair work should be as complete as experience can make it. It should be flexible so as to meet production requirements and changed only for definite, justifiable reasons.

The maintenance manual should be more in the form of a complete file rather than a bound volume. It should include all the available information required for each individual piece of equipment. Manufacturer's prints and manufacturer's maintenance instructions should be organized for use in the planning and execution of each scheduled servicing operation. A detailed description of operation should be part of the file as a guide in adjustment problems that may develop. The record of past repairs or maintenance work on each unit should complete the file and serve as a guide in revision of the master schedule.

You have observed that whenever the work is done in accordance with a prearranged plan, and the equipment is taken out of service for maintenance work, the men and materials ready, and instructions and other facilities available, the work is prosecuted rapidly and effectively. In cases when the unit must undergo overhauling or repair at an unexpected moment, when the need was not anticipated, facilities, materials and drawings not provided, and the best fitted men not available, the job usually is not completed and the cost will usually be excessive.

The value of order is nowhere more evident than in power plant upkeep and repair. Each shift should be made responsible for definite areas and equipment. The operator in that area on another shift should promptly spotlight a condition of equipment neglect if it causes him extra servicing. When possible, give extra credit to your Chief Power Engineer for the condition of your plant. He should believe in the theory "it does not matter what you are doing, if you are working in dirt and disorder your costs are higher than they should be." If your chief or power plant foremen have that philosophy, then you may feel confident that your plant maintenance is in good hands.

Here is one last thought regarding the upkeep phase of preventive maintenance. W. F. Ryan, vice president and engineering manager of Stone & Webster Engineering Corp., with a wealth of experience in both the design and operation of power plants once said, "Why waste time comparing what you did last month with what you did a year ago? Find out what your equipment is capable of doing and compare today's performance with that."

Aim your sights at upkeep, and major repairs will rarely cause you sleepless nights nor gray your hair.

Some Safety Reminders for Electricians

IF YOU have to work in an area which has high-voltage circuits, do you know how close you can get to them and still be safe? Below is a table which gives these distances.

But first, as a reminder, if you have to work on a live circuit use the proper protective devices and equipment. Better yet, if it is possible to kill the circuit do it yourself. Do not start work until you have personally made certain both the circuit breaker and the disconnecting switches are open. Then, if there are still live circuits where you are working, do not approach them any closer than the following distances unless such parts are adequately guarded by approved metal cases which are properly grounded.

751 to 3,500 volts	1 ft
3,500 to 10,000 volts	2 ft
10,000 to 50,000 volts	3 ft
50,000 to 100,000 volts	5 ft
100,000 to 250,000 volts	10 ft
250,000 to 500,000 volts	15 ft
500,000 to 1,000,000 volts	25 ft
1,000,000 to 1,500,000 volts	35 ft
1,500,000 to 2,000,000 volts	45 ft

Finally, treat all low voltage circuits (110, 220 or 440 volt) with due respect. These are the ones most likely to electrocute you. The higher voltages will generally knock you away and you will suffer a burn and mechanical injury. Should you get hold of a low-voltage circuit it will not kick you away, but will hold you right there.

Basic Power Plant FIGURING

A Review for Old-Timers — A Must for Young-Timers

By WILLIAM H. ENGELMAN
Mechanical Engineer
Cleveland, Ohio

How to Specify and Select a Boiler

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WHEN THE power engineer buys a boiler, he must set up some sort of specifications for it, obtain bids on it from a number of manufacturers, and make a detailed comparison of the various bids to determine which one will give him the unit that will meet his requirements at the lowest cost — either the lowest total installation cost or, preferably, the lowest cost per 1000 lb of steam or whatever unit he may wish to select. The second, taking into account fuel costs, fixed charges and operating costs, is the one most frequently used.

Of course, if a consulting engineer is employed, it is part of his job to do this. But in doing it, he must or at least should (and does in all the cases we know of) work closely with the client's power engineers. The latter must be sure that they will get a unit that will meet the load and operating requirements of their particular plant, which they should know better than anybody else. So they should know every detail of the procedure in any case.

One more point: Note that in this article we refer to boiler, boiler rating and similar terms. This is because the specific plant for which figures are given is solely a boiler plant, with only a feedwater heater for a heat-saving device and designed mainly to supply heating and process steam.

Modern practice is to use the term steam generator, defined by ASME as a combination of apparatus for producing, furnishing or recovering heat, together with apparatus for transferring to a working fluid the heat thus made available. The steam generator may thus include superheaters, economizer, air preheater and other elements, as well as the convection surface or boiler proper. More explanation of why we now use the term steam generator in many cases will be given in a later article. However, in this article, for the reasons given above, we'll talk about a boiler. Now let's see what you have to do to get proper bids on one.

First, take a look at Table I. There you will see all the items you should ask the manufacturer for. Items 1 to 19 contain the general design data you request from the manufacturer, on some suitable form, perhaps like Table I. He will fill it in, but if he doesn't do it completely, you call the bid irregular and may reject it.

In Items 20 to 28, the manufacturer will itemize the cost of the boiler he will furnish, while in Items 29 to 44 inclusive, he will give the operating data for three loads, which are absolutely essential.

The following explains each item in detail, where necessary. Table II gives some actual recent costs. Then the various data should be tabulated for comparison as in Table III.

Now let's look at the separate items.

Table I. Data to be requested from boiler manufacturer for comparisons of boiler to be bought

1.	Boiler Manufacturer
2.	Manufacturer's type and designation
3.	Design pressure, 200 psi
4.	Operating pressure, 150 psi
5.	Heating surface, boiler only, sq ft, 3500
6.	Heating surface, water walls, sq ft, 800
7.	Total heating surface, sq ft, 4300
8.	Furnace volume, cu ft, 988
9.	Make of stoker
10.	Type of stoker, single-retort underfeed
11.	Stoker width and length, ft, 8.5 by 9.33
12.	Nominal grate area, sq ft, 76.5
13.	Maximum projected grate area, sq ft, 79.34
14.	Steam drum diameter and length, 42 in x 13 ft 6 in
15.	Mud drum diameter and length, 36 in by 9 ft 6 in
16.	Make of soot blower
17.	Number and type of soot blower
18.	Floor space, boiler length and width, ft, 9 ft 6 in by 19 ft 6 in
19.	Height of unit, steam drum nozzle, ft, 19 ft 8 in
	Itemized Cost
20.	Boiler, stoker, F.D. fan, soot blowers, mountings
21.	Superintendence, special tools, rigging, etc.
22.	Erection labor
23.	Boiler setting, insulation, casing
24.	Total Cost, Erected
25.	Cost per square foot of heating surface, bare
26.	Cost per square foot of heating surface, erected
27.	Delivery after receipt of purchase order, months
28.	Terms: On shipment, net cash, per cent 30 days from shipment, per cent On completion of erection, per cent
	Operating Conditions and Expected Performance
29.	Steam generated, lb per hr
30.	Draft loss through boiler, in. H_2O
31.	Draft loss through damper, in. H_2O
32.	Air resistance through stoker, in. H_2O
33.	CO_2 leaving boiler, per cent
34.	Excess air, per cent
35.	Coal fired, lb per hr
36.	Coal fired, lb per sq ft of grate
37.	Heat release, Btu per cu ft furnace volume per hr
38.	Flue gas temp., first pass, F
39.	Flue gas temp. boiler outlet, F
40.	Flue gas, lb per hr
41.	Flue gas, cu ft per min
42.	Quality of steam, per cent
43.	Over-all efficiency, per cent
44.	Boiler rating, per cent

General Notes

Here are general notes for this type of boiler generating from 8,000 to 32,000 lb per hr of steam (4-hour peak) at 150 psi and 212 F feedwater:

Item 1: — A recognized, reputable manufacturer should be selected. The boiler must meet ASME and local codes.

Item 2: — This should carry the manufacturer's design number and detail. This is important if drawings are misplaced or lost. In such an instance duplicate drawings may be had that will show nozzle location, flange details, and other items such as tube hole, water column, fusible plug locations.

Items 3 and 4: — On this type and capacity of boiler the design pressure is much higher than the operating pressure. The range may be from 30 to 100 per cent for various reasons:

(a) It may be desirable to increase the pressure in the future because of plant expansion.

(b) Cost of construction of small boilers capable of carrying a higher pressure does not seriously affect the total cost of a plant.

Items 5 and 6: — These should be listed separately in any specifications furnished.

Item 7: — Sum of Items 5 and 6.

Item 8: — If furnace volume is known, heat release in Btu per cu ft per hr can readily be calculated. This is important if changes in fuel or fuel burning equipment are considered at some later date.

Table II. Typical itemized costs for the boiler of Table I based on actual bids received as of January 1, 1952

	ITEMIZED COST	
20.	Boiler, stoker, F.D. fan, soot blowers, mountings	$23,500
21.	Superintendence, special tools, rigging, etc.	2,300
22.	Erection labor	5,600
23.	Boiler setting, insulating, casing	6,500
24.	Total cost, erected	$37,900
25.	Cost per square foot of heating surface, bare 23,500 ÷ 4,300 = 5.35	$ 5.35
26.	Cost per square foot of heating surface, erected 37,900 ÷ 4,300 = 8.814	$ 8.814
27.	Delivery after receipt of purchase order, months	8
28.	Terms: On shipment, net cash, per cent	60.0
	30 days from shipment, per cent	30.0
	On completion of erection and acceptance, per cent	10.0

Items 9 and 10: — Make and type of stoker depends upon fuel available and cost. The boiler selected may be designed for a particular type of stoker, such as: chain grate, underfeed (single or multiple retort), spreader. The manner in which air for combustion is introduced, and how products of combustion are carried away, may have a bearing on selection of the stoker. If natural draft is considered, then cost of a chimney of ample size and height must be carefully investigated. Air pollution ordinances in effect, or contemplated, can well govern selection of these items.

Item 11: — This is determined by the boiler size and design.

Item 12: — Nominal grate area is the net effective area and it is, an average, five per cent less than the maximum projected grate area.

Item 13: — This is explained in Item 12.

Item 14: — This is governed by quality of steam required, and by rate of operation and maximum steam demand.

Item 15: — Mud drum must be of ample size to receive all the tubes and permit suspended solids in the water to settle out instead of being carried back to the other portions of the boiler.

Items 16 and 17: — In selection of a soot blower, a standard make should be chosen. The make would be named, and if another make is offered, it should be of equal quality to those named. Blower elements should conform to the vehicle used, either saturated steam or air. Type of blower selected will depend upon whether a fully-automatic cycle is desired or whether manual operation will suffice. This again may depend on local air pollution codes. Number of blowing elements depends on boiler tube location and setting design.

Items 18 and 19: — This is affected by the enclosure for the boiler. If an existing building is used, then the equipment obviously must fit the building. If a new structure is to be erected, it can be designed around the boiler and the auxiliaries. In the latter case, provision should be made for tube removal, walkways, and other items.

Data for the equipment shall be filled in on regular forms, as called for and not on detached sheets. Failure to give the required data will cause the bids to be irregular.

Item 20: — This is the total cost of the boiler and auxiliaries delivered to the erection site.

Items 21 to 23, inclusive: — Usually the boiler manufacturer is better qualified to supervise and erect the boiler than outside contractors as special tools and rigging are available. If special items were required, the cost would be added to the price bid. The manufacturer can also furnish qualified personnel to run the acceptance test.

Item 24: — This is the sum of the totals of Items 20, 21, 22 and 23.

Items 25 and 26: — This provides a comparative cost analysis of the bids from various manufacturers, both on a delivered basis and on an erected, ready for operation basis.

Item 27 and 28: — Self-evident.

At least three performance guarantees for three loads must be listed by each bidder in order that a good comparison can be made. This is because of the fluctuations in efficiency that occur when the demand load changes. Each listing should include each of the sixteen items from 29 to 44 inclusive.

Item 29: — The purchaser should specify what the minimum and maximum steam demand will be.

Items 30 to 32: — These items must be known to determine size of fan or fans, and the horsepower required to operate them. If natural draft is to supply air for combustion, the draft losses will determine size and height of the stack.

Item 33: — This is an indication of losses due to poor combustion. It is affected by fuel used, method of firing, and construction of the furnace. All fuels require an excess of air above the theoretical air for combustion. Amount of excess air supplied will also have a distinct bearing on analysis of the flue gases.

Item 34: — Excess air is necessary but the method by which it is introduced can spell the difference between efficient and inefficient results. With proper introduction, amount of excess air can be held to a minimum. Flue gas analysis will give the answer, but the bidder should include a guarantee as to what percentages can be had of Items 33 and 34.

DON'T CLIP THIS ARTICLE

Others in your plant may want to read the complete issue, so if you want an extra copy of this or any other article, ask the Editor for tear sheets or a reprint. For convenience, use the postage-free card that you will find elsewhere in this issue.

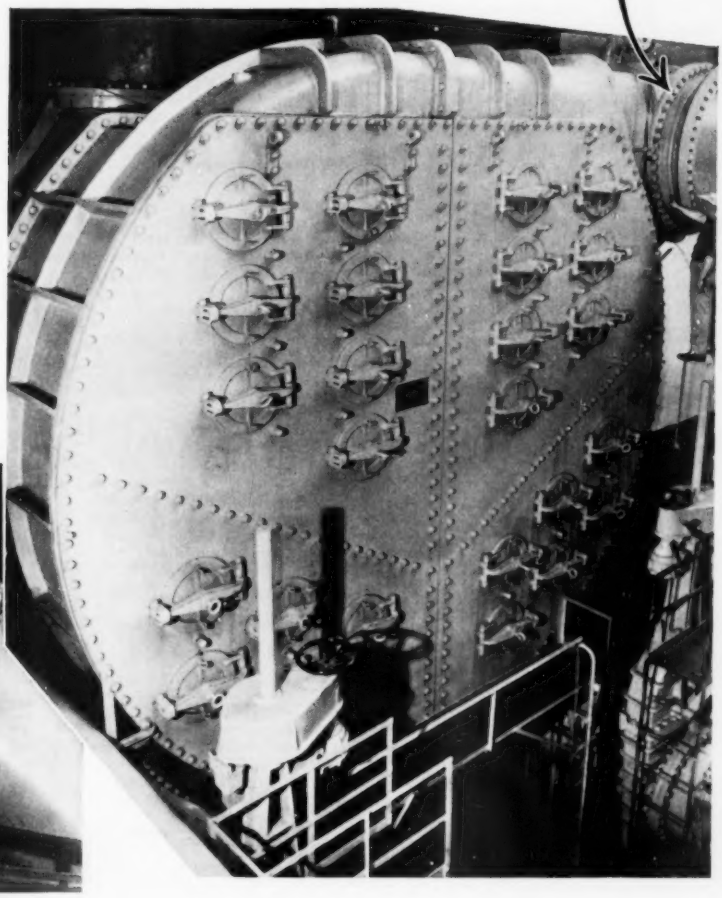
Table III. Convenient form for compilation and comparison of data used in bids on the boiler of Table I

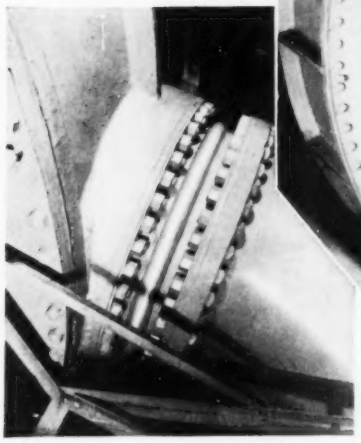
Bidder	Company A	Company B	Company C
Steam generated, pounds per hour	15,000	15,000	15,000
Draft loss through boiler, in. H_2O	0.14	0.15	0.16
Draft loss through damper, in. H_2O	0.03	0.03	0.02
Air resistance through stoker, H_2O	0.15	0.15	0.15
CO_2 leaving boiler, per cent	11.5	11.5	12.3
Excess air, per cent	60.0	60.0	49.0
Coal fired, pounds per hour	1,570	1,545	1,590
Coal fired, lb per sq ft of grate	20.5	19.1	19.6
Heat release, Btu per hr per cu ft furnace vol.*	19,800	20,200	19,000
Flue-gas temp., first pass, F	1,250	1,440	1,655
Flue-gas temp., boiler outlet F	465	445	482
Flue-gas, pounds per hour	24,500	24,200	22,600
Flue-gas, cubic feet per minute	9,500	9,170	8,700
Quality of steam, per cent	99.5	99.5	99.5
Over-all efficiency, per cent	77.7	79.3	76.73
Boiler rating, per cent	104.0	98.0	111.0
Steam generated, pounds per hour	25,000	25,000	25,000
Draft loss through boiler, in. H_2O	0.40	0.39	0.36
Draft loss through damper, in. H_2O	0.06	0.05	0.05
Air resistance through stoker, H_2O	0.15	0.15	0.15
CO_2 leaving boiler, per cent	13.0	12.8	13.6
Excess air, per cent	42.0	45.0	35.5
Coal fired, pounds per hour	2,640	2,635	2,710
Coal fired, lb per sq ft of grate	34.5	32.5	33.4
Heat release, Btu per hr per cu ft furnace vol.*	33,400	34,500	31,800
Flue-gas temp., first pass, F	1,500	1,740	1,985
Flue-gas temp., boiler outlet F	520	520	560
Flue-gas, pounds per hour	35,300	37,000	31,200
Flue-gas, cubic feet per minute	14,500	15,250	14,500
Over-all efficiency, per cent	77.0	77.4	74.9
Boiler rating, per cent	173.5	163.0	184.5
Steam gen., lb hr., 4 hour peak	32,000	32,000	34,000
Draft loss through boiler, in. H_2O	0.57	0.60	0.66
Draft loss through damper, in. H_2O	0.09	0.10	0.08
Air resistance through stoker, H_2O	0.15	0.15	0.15
CO_2 leaving boiler, per cent	13.5	13.2	13.9
Excess air, per cent	37.0	40.0	33.0
Coal fired, pounds per hour	3,470	3,500	3,900
Coal fired, lb per sq ft of grate	45.4	43.1	48.2
Heat release, Btu per hr per cu ft furnace vol.*	43,900	45,800	44,000
Flue-gas temp., first pass, F	1,650	1,900	2,170
Flue-gas temp., boiler outlet, F	530	585	629
Flue-gas, pounds per hour	44,900	46,500	47,100
Flue-gas, cubic feet per minute	18,600	20,250	21,100
Over-all efficiency, per cent	75.0	74.7	70.8
Boiler rating, per cent	—222.0	209.0	247.0

*Note: To first row of boiler tubes.

After 20 years, the same U. S. Rubber Expansion Joints still protect this condenser

Main power plant condenser, showing 72" U.S. Rubber expansion joint on discharge pipe at upper right. Lower photograph shows close-up of 42" expansion joint on intake connection.





That's a long time in any industry. This southeastern power plant still gets perfect service from these U.S. Expansion Joints. Pipes are protected from expansion and contraction and the effects of vibration. It's easy to see why this plant, like so many others throughout the nation, uses "U.S." Expansion Joints exclusively. Let U.S. Rubber engineers help you handle your expansion joint problems.

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UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Items 35 to 37: — After the unit has been placed in regular operation, amount of fuel burned and heat release will be governed by the steam demand. Furnace design, method of burning, and class of fuel will affect these items. The bidder should investigate the type of fuel available before stating the results obtainable.

Item 38 to 41: — These are governed by rate of operation. Heavy demand will increase the speed of gases flowing through gas passages, with resulting increase in gas temperatures and volume. The higher the temperature of the gases leaving the boiler outlet, the lower the efficiency. Too much excess air will increase the outlet temperature due to the greater volume that must be discharged to the atmosphere.

Item 42: — Quality of the steam to be delivered depends upon the process involved. If power is to be generated, then dry steam is necessary; but if a heating load or some process is involved, then a high-quality steam may not be imperative. Any boiler must be capable of delivering dry steam at any rating for which it is designed. This may be done by one of several means such as using dry pipes, scrubbers, and the like.

Item 43: — Over-all efficiency will be governed by numerous factors: fuel available, method of burning, design of combustion chamber, of heat-absorbing surface, and other items. After the boiler has been in service for a time, purity of the feedwater will have an effect on the efficiency, but this is not a responsibility of the boiler manufacturer.

Item 44: — Boiler rating as defined by the bidder should clearly state the capacity that may be expected under various conditions of demand. Length of time the peak rating can be maintained should be clearly stated. Normal rating which can be maintained for indefinite periods of time should also be specified.

General Comments

The acceptance test should be run in accordance with the ASME test codes. By so doing, a complete and permanent record will be made for future reference, if necessary. It will be possible, in such a case, to readily determine whether or not the unit is operating satisfactorily from a standpoint of over-all efficiency.

The test should be run under the supervision and direction of a qualified registered engineer. This will insure a fair and unbiased result. A recognized and reputable manufacturer will not protest such a request

All welding of pressure parts will require the services of a certified welder, and such a welder should be retained for all other welding services.

Inspection during the entire time from breaking ground to the completion of all work should also be by, or under the direction of, a qualified registered engineer. Any alterations or changes that may be necessary during the course of the work can be approved without the possibility of weakening the finished job.

The bidder should submit a complete answer to the specifications listed by the consultant and retained by the purchaser.

The foregoing comments can be enlarged upon and different engineers will have personal ideas as to how the various items should be given. This is intended only as a guide for engineers who will be called upon to select, or assist in the selection of power plant equipment of similar size and design.

PRACTICAL HINTS AND KINKS

Reel-Turning Made Easy

TWO LENGTHS of pipe, one just small enough in diameter to allow it to slip into the other, comprise a reel-turning device that simplifies a task which can require the all-out efforts of four to six men. These lengths are adjustable for various size reels.

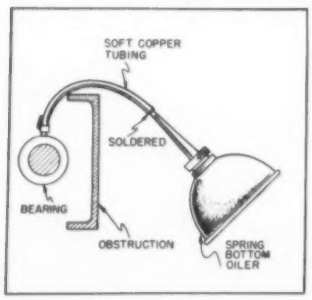
The reel turner is operated by slipping a steel ring, welded to the protruding end of the smaller pipe, around a pipe which has been placed through the center of the reel of wire. Task of turning the reel with this device will require only two men.

Oil Can with 'Education'

By JOHN FOSTER

SOMETIMES it is difficult to reach oil holes in remote locations on machinery with an ordinary spring bottom oiler. A solution to this problem consists of soldering a suitable length of small diameter soft copper tubing to the end of the oiler spout, as shown. The copper extension can then be bent to exactly the shape required.

Spring bottom oil can with copper tube extension



Tight Screwed Connections

By W. E. WARNER

SCREWED connections in conduit, etc. which have to be effectively earthed and watertight should have tight threads.

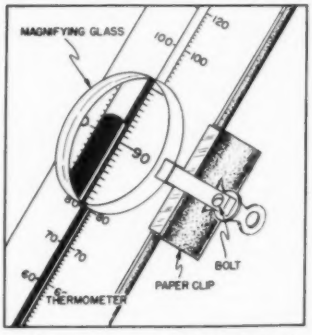
This is not always easy because pipe dies wear and cut a poor thread. When this happens a loose connection and a film of rust on the threads is the result. To prevent this, just start the threads and then paint the remainder of the threads with a thick paste made from lead or solder filings and gasolene. Then tighten the connection. This will force the filings into both sets of threads making a watertight, gastight, and good electrical screwed connection.

The gasolene will soon evaporate and is only used to make the filings easy to apply and more adhering.

Thermometer Improvement

By THOMAS TRAIL

BY attaching an inexpensive plastic handled magnifying reading glass to an ordinary spring type paper clip, as shown, the glass can be readily attached to a thermometer, at whatever point desired, to facilitate reading the indication.



Magnifying glass shown attached to a paper clip

Transformer Tank Cutter

A CUTTER, especially designed for making an opening in a transformer tank prior to attaching cooling radiators, can be a big time saver. Usually cores must be removed and a hole burned in the tank with torches, a task which might take two weeks.

By placing cutting tools in a piece of metal with a ratchet handle on it, the hole can be cut without removing the core. The tool is spot-welded to the tank so that when a piece is cut it will not drop into the coils. A job done this way can be done in two days without removing the core.

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Remember: Waste as little as one percent of the fuel burned during the life of your boiler, and the cost of the wasted fuel can equal five, six, or even seven times the original cost of the control system!

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Questions and Answers

Question No. 500

How Can He Forestall Diesel Crankcase Explosions?

FAILURE OF A PISTON caused a serious explosion in the crankcase of a diesel engine in a nearby plant recently. Since our plant has an engine of similar design, though of different make, we are wondering whether we can provide additional safety measures to prevent a similar explosion in our engine.

Our engine is provided with the usual overspeed trip; but we feel that if the engine were equipped with a device that would shut it down in case pressure in the crankcase exceeded a safe limit, we would greatly lessen the danger of explosion.

Devices of this kind are on the market but we have had no experience with them and should like to know whether any of the readers of this section have had such experience. Are these devices effective, and would it be worth our while to install one?

Quincy, Mich. C. D. M.

Answer No. 496

How Should He Hook-Up Synchronizing Transformer?

H. H. C. HAS ONE transformer from the grounded wye side of a 12-kv oil circuit breaker, another identical transformer on an ungrounded delta side of the same switch. His problem is how to connect the transformer on the delta side so that it will not suffer in the event of a ground on the delta side?

Comments By Fitzpatrick

WHILE UNDER-VOLTAGE relay could be applied as a voltage fault detector, removing synchroscope from circuit, fuses offer the most economical and fool-proof solution to the problem. Generally, fuses should be used in both primary and secondary potential transformer circuits. In addition to furnishing high-current protection on the primary side, fuses also protect high-voltage circuit from fault that could develop in the potential transformer circuit.

Fuses are usually omitted in connections to grounded terminals and for certain applications involving regulators and protective relays.

Fuse selection in this instance would be based on interruption of maximum short-circuit current that could occur at the fuse block; to open the circuit if fault would occur near potential transformer secondary terminals; and, maintain the circuit under inrush magnetizing current that occurs during closure of the breaker in normal switching operations.

In every installation it is important to observe manufacturer's synchroscope connections. While it is possible for the indicator to appear to operate normally with incorrect connections, synchronism and relative prime mover speeds depend upon phase and polarity relationships. Considerable damage to generating equipment is possible when attempting to parallel machines and systems on the basis of indications given by incorrectly connected synchroscope.

Polarity markings on transformers must be closely observed, as reversal of one connection will result in incorrect indication of circuit conditions.

L. W. FITZPATRICK
Jefferson City, Mo.

Answer No. 497

Should He Install Additional Deaerator?

IN THE MAY ISSUE, J. G. D. stated that steam consumption at his plant was going to increase to 120,000 lb per hr. Capacity of his present deaerator is only 80,000 lb per hr. He wanted to know if he should install an additional deaerator or a larger single unit, what capacity deaerator would be required, and how many pounds of steam would be required per hr for the new deaerator? Here are some more answers from readers.

Single Deaerator Needed, Says Evans

IN CALCULATING deaerator size, 8 per cent blowdown and 2 per cent outgoing heat were assumed as a loss, giving 130,500 lb per hr of water to be deaerated, including condensate and 11,850 lb per hr of 5.3 psig steam for heating. A 4-in. line with 4 ells, 2 gate valves and a 20-psig drop across the reducing valve is required. Valve size depends on seat and disk design. From the flow, 20-psig pressure drop and the average steam pressure on the upstream side of the valve, 26 psig, the valve manufacturer will recommend correct valve size.

A new deaerator is required. It would be difficult to maintain correct flow if two small ones were used in parallel, and such a plan would waste space. Use a deaerator with a capacity 15 per cent greater than your 130,500 lb per hr at 5.3 psig with a 0.03 cu cm oxygen guarantee, and with 60 per cent return and 40 per cent makeup with a vent condenser.

Chicago, Ill. M. EVANS

Try Steam-Jet Unit

EVERY DEAERATOR manufacturer, to secure a definite acceptable oxygen removal, deliberately low-rates his deaerating capacity on the drawing board. This safety factor ranges from 25 to 50 per cent and in using a deaerator at over-rating, the sole limiting factors are the aforementioned oxygen removal from the feedwater and the water outlet temperature.

However, with many tray-type units, steam and water velocities build up on peak loads making the unit extremely noisy and introducing considerable vibration, which is transmitted by the piping to the entire plant, making an unsatisfactory installation.

One workable solution without the purchase of a new supplementary deaerator is the substitution of a steam-jet type deaeration unit. This is a simple replacement of the original tray-type deaerator over the water storage section.

Steam-jet types have the additional advantage of closer control over outlet water temperature. Practically every deaerator manufacturer can supply this type jet system for his original equipment.

In one installation of this type, the new steam-jet type successfully produced almost 200 per cent rating of the original deaerator and had the same acceptable oxygen-removal rating. The over-all installation in addition made possible considerable saving in re-piping as most of the original piping installation was utilized with higher velocities in the new setup.

L. W. FITZPATRICK
Jefferson City, Mo.

Answer No. 498

Will His Pump Lose Suction After Shutdown?

IN THE JUNE ISSUE W.M.L. stated that it was planned to change from a reciprocating duplex to a centrifugal 1500-gpm fire pump for hydrant supply. No foot valve was being considered. W.M.L. summarized his question as follows: Would all the salt water be lost from the 530-ft suction pipe after each shutdown and pass back into the bay? Would the density of salt water and equalized pressure over the bay have sufficient effect to hold much water in the pump?

A centrifugal pump salesman, and many readers, have said the pump *will* lose suction after each shutdown. Now, here are more comments.

The Real Problem?

EACH TIME I pick up the June issue of POWER ENGINEERING, the illustration for Question No. 498 catches my eye and raises one question after another. Things are all too often not what they seem. I have gone on so many jobs where the *real* problem was entirely different from the *original* one, that I cannot help but call attention to some points involved in this problem.

A centrifugal pump suction, as shown in the original drawing, should slope upward to the pump to prevent

NO GETTING AROUND IT

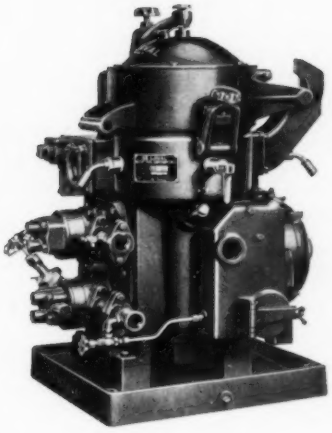
CENTRIFUGING DIRTY OIL PAYS BIG DIVIDENDS

A De Laval Oil Purifier makes every machine tool in the plant a better producer. Using centrifugal force to remove solid impurities ***and*** water from all types of factory oils, De Laval Oil Purifiers restore used oils to "like-new" clarity and cleanliness. They do this continuously and virtually instantaneously.

But the dividends don't stop there! Production advantages are often as important as the savings in oil. Take the advantages of purifying cutting oil, for instance—

1) Tools cut better because the metallic particles that ruin cutting edges have been removed.
2) The machine tools last longer because harmful grit and dirt and chips are absent.
3) Work output rises because uniform quality of cutting oil helps to maintain uniformity in cutting work.

De Laval Oil Purifiers "pay dividends" in small as well as in large plants. Write for Bulletin MM-1 for a checklist of possible applications.



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air pockets and possible air binding. The bell-mouth inlet is also good engineering. The long suction line is not desirable, particularly for a fire pump, but was probably dictated by steam plant location. Rest of the problem is vague and uncertain, with few necessary values given.

The question will probably be answered both yes and no, depending on the assumption of how tight the discharge can be maintained. In my opinion the answer is academic, and relatively unimportant to a practical solution to the problem of changing pumps.

First question should be: Is the pump for fire protection, or for an industrial application? If fire protection, analysis of the problem would be more elaborate, and W.M.L. should consult not only the agency carrying insurance on the properties, but other agencies as well. Installation can materially influence rates now, and later. Competent engineering advice should be sought, since the problem involves too many items to be fully considered by letter. Some on-the-job decisions may be necessary, such as:

(1) Is the new pump to be motor or turbine driven? Why? If motor driven, power supply must be carefully checked for reliability and compliance with insurance requirements. If turbine driven, a similar analysis must be made (i.e. cost comparisons with motor drive, first cost, operating cost, stand-by cost).

(2) Should a centrifugal or some other type of pump be used? Location and housing of the pump must also be considered.

In my mind there is considerable question as to whether the pump is solely for protection. What does W.M.L. mean when he says the pump will be shut down frequently? Fire protection pumps are usually shut down. They are normally operated only as required for test. Ordinarily, operating a 1500-gpm centrifugal pump to maintain line pressure would not be economically sound. It would appear, therefore, that large volumes of salt water are required for some kind of commercial enterprise. Rearrangement of temporary discharge piping to hose hydrants, or weekend halts of operations could be the reason for frequent shut down. A centrifugal pump installation for fire protection would require a foot valve as well as a discharge check valve, special piping and primary arrangements.

Does W.M.L. know that a centrifugal pump will not lift water like a reciprocating or positive displacement pump? Does he know that the suction pipe and the pump must be completely full of water before the pump is started?

Without a foot valve, pump casing and the long suction piping would be under negative pressure at all times. Properly adjusted packing in the stuffing box is not air tight. Priming of the casing would probably be required for all but the shortest of shutdown periods.

While steam syphons, water eductors, mechanical vacuum pumps or other sources of vacuum may be used to prime a centrifugal pump, it would appear that a foot valve would simplify W.M.L.'s problem. If the valve is tight, once the suction line is primed it will remain so over a reasonably long period. Also, if the discharge pipe is full of water the pump can be quickly primed using a bypass around the discharge check valve; or any other source of water may be used to fill the line and pump casing.

Marine growth in salt water piping is often a problem. Control of this growth is facilitated where a foot valve prevents dilution of chemicals pumped into the line during shutdown.

I presume screens are provided to keep debris, trash and fish out of the line. If a clogged screen allows sump water level to lower so that air is momentarily drawn in, the centrifugal pump can become air bound. A positive displacement pump will merely have its capacity reduced somewhat.

I have wandered somewhat, but I sincerely hope that some of the remarks will be of help.

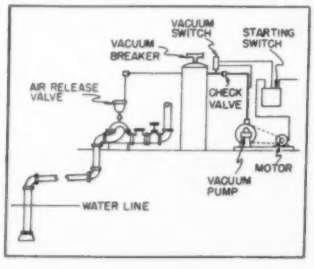
Waterford, Conn. EDWIN SIBLEY

Definitely Yes

THE ANSWER is definitely yes. No centrifugal pump will operate satisfactorily on intermittent service with a static head of 7 ft maximum, as W.M.L. states this pump must, without a foot valve or some type of automatic priming device.

Perhaps the salesman did not explain why this is so, when the reciprocating pump now operates without a foot valve. It must be remembered that characteristics of the two pumps are not the same. The reciprocating duplex pump is a positive displacement pump and, as such, will handle air as well as water; but when the centrifugal pump is running at its regular speed it will pull very little vacuum, stated in feet of water. Thus, it would not prime itself, and due to its construction would not hold a vacuum in the suction line very long after it stopped running. As a result, all water in the line, except in that part below bay water level, would run back into the bay.

Tatman recommends automatic vacuum priming



Density of water in the bay will have no effect in holding any water in the suction line. Water in the line is the same as water in the bay, and both will have the same density. Atmospheric pressure acting on the surface of the bay is 14.7 psi. With no vacuum in the suction line there will be pressure of 14.7 psi acting on water in the line plus the head (1 lb for each 2.31 ft). Water will be pushed out of the suction line into the bay, until the two heads of water just balance each other. If the centrifugal pump is not equipped with a check valve on the discharge side of the pump, water in the discharge line, if it has any static discharge head, will flow through the pump and back into the bay.

A foot valve must be kept clean and in good working condition at all times, or it will leak, causing the pump to lose prime. Running dry may cause wearing rings of the pump to run hot and seize.

It may be desirable to equip the pump with some type of automatic vacuum priming system. This consists of a vacuum tank, vacuum pump, and motor operated automatically by a vacuum switch, shown in the illustration. Such a system requires no foot valve for it will keep necessary vacuum in the centrifugal pump and suction line to allow atmospheric pressure on the bay to support a column of water up to and including the pump.

The same pump can be manually primed by an ejector operated with steam or air, but to be self-priming it must hold water in the pump and suction line with a foot valve. In addition there must be some source of water to fill the suction line the first time and to make up any water that may leak out if the pump is not run for some time.

Puerto Rico W. O. TATMAN

Money a Factor

SOLUTION TO W.M.L.'S centrifugal fire pump problem would depend upon money available for conversion. There are several types of installations which merit consideration. In an installation popular with power plants, the pump could be located in a concrete pit below bay water level. In a somewhat similar instance, the pump could be placed in the plant basement below bay water level, with suction pipe buried in the earth.

Cheapest installation, shown in the diagram, uses present piping and pump foundation. Note that the pump is full of fresh water when not in use. This is usually supplied by a $\frac{3}{4}$-in water line, under pressure, from a plant water system, shown as A. Periodic inspection and venting (valve at E) will maintain pump in proper starting condition. Check valve B in the pump suction pipe will prevent fresh water from flowing to the bay. Gate valve C can be closed and hydrants drained to prevent freezing in winter. Valves D1, D2 and D3 are drains to remove salt water.

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COPPER ALLOY BULLETIN

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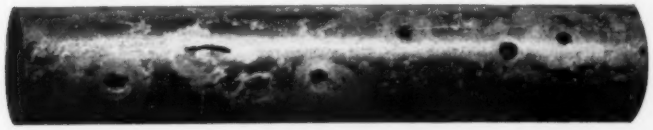


(Top, Fig. 1.) A non-inhibited Admiralty tube which failed from plug-type dezincification accelerated by the hot wall effect.

(Bottom, Fig. 2.) Photomicrograph of section of this tube. In the upper half of the corroded area, part of the copper plug has been converted into black copper sulfide, which has dropped out leaving a shallow pit. Unattacked Admiralty is evident on both sides of the corroded area. Mag. 25X.

Improving Efficiency and Extending Tube Life by Good Operating Practices

When a section of a refinery or chemical plant is shut down for major repairs and overhauling, careful examination and diagnosis of tube failures in condenser and heat exchangers are very important as the results may lead to remedying conditions which shortened tube life.

One of the major causes of copper-base alloy tube failures is operating them at temperatures higher than those for which the metal is designed to withstand comfortably. Even intermittent periods of excessive heat may do considerable damage. Consequently, temperature control of various operations is most essential.

A basic cause of overheating may be the clogging or blocking of the tubes which carry the cooling water or liquid. Cleaning and removal of debris at the inlet ends of the tubes should be done as often as necessary. This condition is aggravated during and after stormy periods and floods. The use of screens and strainers to keep foreign matter from entering the equipment can do much to keep the tubes from overheating. At one plant, shutdowns that occurred every six months have been changed to every 16 months and even longer through careful maintenance and control of operating conditions.

Tube Failure From Hot Wall Effect

Figure 1 illustrates a ¾" O.D., No. 16 BWG non-inhibited Admiralty tube which was removed from a thermal catalytic cracking unit in an overhead condenser. It failed from plug-type dezincification after four years service. The tubing had been installed in a horizontal position. Perforation had occurred in the ceiling of the tubing only.

A metallurgical examination of the tube wall showed that plug-type dezincification started from the inside (water side). When the plugs of copper extended completely through the tube wall, they were rapidly attacked by the sulfur compounds in the hydrocarbon liquid and vapors surrounding the outside of the tubes. The holes formed rapidly after the copper plugs had changed to copper sulfide.

The circulating water inside the tubing which was not particularly corrosive, averaged between 110-120°F at the exit end. The product temperature (on the outside of the tubes) was approximately 300°F.

The severe local corrosion which occurred is attributed to the hot wall effect. This occurs where bubbles or debris separate from the circulating water and cling to the metal surface at which points they act as localized heat insulators, the metal approaching the temperature of the hot liquid on the outside. Corrosion at these points proceeds at a higher rate due to the accelerating effect of increased temperature.

Dezincification Can Be Avoided

Dezincification would have been unlikely if arsenical Admiralty (inhibited against dezincification) had been used. This change in alloy should result in increased service life of the tubes.

Suggested measures for increased tube life are:

1. Increase velocity of coolant to dislodge bubbles of gas and debris, but avoid too high water velocities which lead to impingement corrosion.

2. Keep tubes clean. Remove debris, mud, silt or rust promptly.

Changing practice such as increased water velocities may lead to other types of attack such as impingement corrosion. If arsenical Admiralty does not stand up satisfactorily under these conditions, it would be well to consider the use of Arsenical Aluminum Brass which withstands impingement corrosion better than Admiralty and has equal resistance to sulphide corrosion. Where high temperatures are unavoidable and the sulfur content in the hydrocarbons is comparatively low, 70-30 Cupro Nickel should be tried out. This alloy has a higher creep strength at the higher temperatures than the brasses and is also much less affected by ammonia.

The Bridgeport corrosion laboratory will be glad to cooperate with corrosion engineers in refineries and chemical plants on their corrosion problems connected with copper-base alloy tubes.

(8550)

A small aspirator or siphon, S, operated by steam, water or air (minimum pressure 70 psig) is connected to the highest point of the suction pipe at M on the bay side of the check valve. The manufacturer will furnish data on the aspirator rating. It will create a vacuum of about 22-in. of mercury in less than one minute. It would be safe to assume that water would travel about 4 fps in the pipe — so that the entire 530 ft of suction pipe would be filled with bay water in about two minutes. When the short pipe connected at M leading to the aspirator gets cold, the operator can tell the suction pipe is full.

In answer to W.M.L.'s question pertaining to behavior of liquids in pipes and closed containers, level of the liquid in the suction pipe would be the same as water level of the bay. Specific gravity of sea water (1.025) is not great enough to cause serious error in calculations of this type. We can assume that absolute pressure of liquid at the surface is the pressure of gas or air on the surface.

When W.M.L.'s pump is filled with sea water, absolute pressure of water at the surface of the bay would be at barometric pressure for that particular day. For example, the barometer reads 30 in., or 14.7 psia (30 times 0.4912 equals 14.7 psia). Absolute pressure of water at the top of the suction pipe (at M) would be dependent upon the tide.

At high tide it would be:

$$14.7 - \left(\frac{2.5 \times 0.4335}{1.025}\right) = 13.1 \text{ psia}$$

At low tide it would be:

$$14.7 - \left(\frac{7.5 \times 0.4335}{1.025}\right) = 11.5 \text{ psia}$$

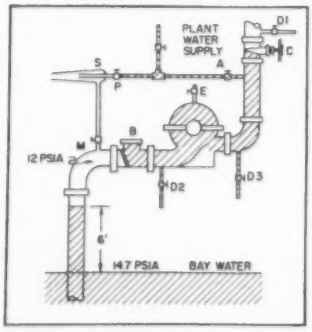
Where 2.5 and 7.5 equals the height water must be lifted to the pump; 0.4335 equals the conversion factor from ft to lb; and 1.025 equals the specific gravity of sea water.

These figures will be somewhat lower when applied to a running pump because some of the pressure (potential energy) is converted to kinetic energy to move water from bay to pump.

When the pump is shut down, some air will find its way into the suction pipe, and some water will recede to the bay. By this process, when enough pressure of air over the bay is the same as that of air in the pipe, the levels would be the same.

Chicago, Ill. WALTER HEIDECKER

Cheapest method uses old pipe and foundations. Note the pump is full of fresh water when not in use



Comments by Winterstoen

THE QUESTION states: (1) that the new pump for hydrant service will be centrifugal; (2) that no foot valve is being considered or utilized; and (3) that the pump will not be in continuous service.

As suggested by the pump company salesman, the water column standing at the terminal drop pipe would have no effect toward holding water inside the suction line. Only factor influencing retention of water in the suction line at pump shut down would be tightness of pump suction and discharge line joints, discharge valves, and shaft seals on the pump. Air leaking into the system from any source would break the vacuum which must be maintained to keep the suction pipe filled.

This pump should be kept primed and ready for immediate service. Since a foot valve is not being considered, I would recommend that a gate valve be installed at the pump discharge which should be kept closed when the pump is down. A priming system should also be installed on this pump and gages added to the pump suction and discharge.

A gate valve on the pump discharge will isolate discharge piping and eliminate air leakage from that source; the priming system is a must for any centrifugal pump without flooded suction; and, the gages give an indication of pump performance. The vacuum gage on pump suction will also give the pump operator a visual check on whether the pump is primed before he starts it.

Munhall, Pa. J. C. WINTERSTEEN

Eventually, Says Schieck

W. M. L. HAS a problem the very first time the new pump is put into service since the suction line will be filled with air. Air must be removed by priming so water in the suction line may be brought close enough to the pump impeller in order that it may impart its energy to the water.

After a pump is shut down, a partial vacuum is formed in the suction line at the impeller, and due to atmospheric pressure, which exerts a force of approximately 14.7 psi on the surface of the bay, a column of water is supported in the suction line of the pump. In a *near perfect* vacuum the atmosphere will support a column of 29.9 in. of mercury, 33.9 ft of water, or 32.8 ft of sea water. With a partial vacuum formed on the inside of the pump there is a tendency for air to leak into the pump through the suction line joints and stuffing box. If air leaks in, slowly filling up the partial vacuum, the level in the suction line drops until it is level once again with the surface of the bay. When this condition is reached, the partial vacuum has been completely filled with air, and pressure inside the suction line is the same as pressure outside, 14.7 psi. Once again the pump must be primed.

As indicated, the time in which the pump loses its prime depends on suction-line tightness and stuffing box conditions. Since W. M. L. plans to use this pump as a fire pump for hydrant supply it would probably be shut down for long periods during which it would lose its prime. Because of the importance of this pump in a fire protection system, I would advise W. M. L. to install a priming system to be certain that if and when water is required it will be obtained. Secondly, I doubt very much whether fire underwriters would approve such a pumping arrangement without a satisfactory priming system.

A check on the net positive suction head of this pump shows an available NPSH of 15 ft, which indicates that once this pump is primed at start-up it would operate satisfactorily if the length of shutdowns are not too long.

R. R. SCHIECK

Niagara Falls, Ontario

Yes, Even With Salt Water, Says Trncak

I THINK W. M. L. will find that the density of salt water will have no effect in holding water in the suction pipe because *any* liquid will seek its level, regardless of weight or density.

This, I believe, is where W. M. L. will find the greatest difference between his old reciprocating pump and the new centrifugal pump. In the centrifugal pump, regardless of how good the packing or how well it is adjusted, some air will leak in whenever the pump is shut down. On a reciprocating pump, if the valves hold tight, no air will enter the suction line because the suction valves are between the packing glands and the line.

I would suggest that a foot valve be installed to hold water in the line. The valve would pay for itself because of the unnecessary length of time now spent in priming the pump, especially if it is started and stopped frequently as W. M. L. states.

East Alton, Ill. JERRY TRNCAK

Yes, But Foot Valve Will Help, Says Cochrane

THE 530 FT of suction line naturally will drain as water seeks the lowest level, whether in a pipe or in a pond. Lowest level in this case being the bay level at the time.

In order to be at all sure of a supply of water when needed and to save the pump from running dry, a foot valve is absolutely necessary. I have not had experience with centrifugals on this type of use, but I doubt if it would ever pull water that far without a foot valve to keep the pipe full.

So, W. M. L. must either buy a foot valve — or a different type of pump.

Milaca, Minn. D. L. COCHRANE

ABC's of Combustion Control

Combustion control, or more properly boiler control, requires coordination of five important factors. Here is a simple, straight-forward explanation of the fundamentals

By ALFRED C. WENZEL
Chief Project Engineer
Republic Flow Meters Co.

IN MODERN POWER plant practice, combustion control is assumed to include all factors required to provide complete boiler control with the exception of feedwater level control. In fact, in many large installations, control devices are interconnected in such a manner that it becomes a simple matter to make boiler feedwater control a part of the integrated system.

The problem of boiler control is one of coordinating five factors: steam pressure; fuel quantity; combustion air quantity; removal of waste gases; and feedwater supply. Every steam boiler regulating system must recognize these factors, and must proportion and coordinate the last four factors at all times. At the same time, steam pressure must be kept approximately constant at all times.

Because of this, practically all commercial boiler control systems use the tendency for steam pressure to deviate from its set point as a master control impulse. A tendency of steam pressure to drop will cause an increase in firing rate of the boiler; while a tendency of steam pressure to rise above the set point will cause a decrease in firing rate.

Combustion Factors

Efficient combustion depends on how three factors, fuel, combustion air and waste gases, are handled. Some means, direct or indirect, must be provided for proportioning fuel and combustion air, and for maintaining furnace draft at proper value. The means selected for a given installation depends on: (1) money available, (2) size of installation, (3) type and number of fuels burned, (4) magnitude and frequency of load variations, (5) type and number of boiler auxiliaries, and (6) type, size, and method of controlling equipment already installed.

In order to properly control fuel, combustion air, waste gas and feedwater level, they must be measured quantitatively as the basis for control action; or some other effect, which can be relied on as being proportional to quantitative measurement, must be used. These "measurements" or "effects" are commonly referred to as check backs. (In radio work and electronics they are called feed backs.)

Check Backs

Check backs commonly used to control these factors are:

For Coal: — (1) Speed of stoker or feeder drive shaft. (2) Position of coal feed lever, either on a coal feeder or its variable speed drive. (3) Position of valve on a hydraulic or pneumatic coal feeding mechanism.

For Oil: — (1) Measurement of differential pressure across an orifice located in the fuel oil line. (2) Oil pressure ahead of burners (useful with constant tip size burners). (3) Control of back pressure on return-type burners. (4) Positive displacement type of measuring device.

For Gas: — (1) Measurement of differential pressure across an orifice located in the fuel gas line. (2) Gas pressure measured between regulating valve and burners.

For Air Flow: — (1) Differential pressure across orifice or venturi in forced draft duct, or drop across air side of air heater. (2) Suction (static pressure) at forced draft inlet cone can be used on variable speed forced draft fans, driven by turbines, magnetic or hydraulic couplings or variable speed motors. (3) Differential pressure between wind box and furnace (with oil or gas burners when oil or gas pressure is used as a check back for fuel measurement). (4) Indirect air flow measurement by using draft loss through boiler setting, gas side of air heater, or across dust collector. (5) Variable furnace draft on boilers burning oil or gas and lacking forced draft fans. This is equivalent to taking draft loss from wind box to furnace where oil or gas pressure is a check back for fuel measurement. (6) Constant furnace draft (when air is indirectly measured, as in No. 5, and controlled by boiler outlet damper). Forced draft fan is used to supply combustion air in amount governed by furnace draft regulator.

For Waste Gases: — (1) Measurement of draft loss across boiler passes on flue gas side of air heater or through dust collector. (2) Furnace draft held constant at all rates of steam generation by controlling boiler outlet damper.

For Feedwater: — (1) Single element control using drum level only as controlling impulse. (2) Two element control using steam flow impulse (measured across orifice in steam line, or pressure loss through superheater) producing a water valve position corrected by drum level impulse. Note: This type of regulation is satisfactory only when feedwater header pressure is constant or differential pressure across the feedwater control valve is held constant. (3) Three element control comprising steam flow versus water flow control with correction from feedwater level. Further reference to feedwater control will be omitted.

Control Classified

Boiler controls can be classified by function and use — from the simplest to the most complex. General classifications and their variations follow (letters in parentheses refer to diagrams on next page):

Positioning Control (a): — Simplest form uses single regulator with single boiler, requires one fuel, and stack draft only. Regulator controls boiler outlet damper and fuel (stoker, oil or gas) by position only.

Positioning Control (b): — Modified control uses two regulators with a single boiler, single fuel and forced draft fan. Steam pressure regulator controls fuel and forced draft; furnace draft regulator operates boiler outlet damper.

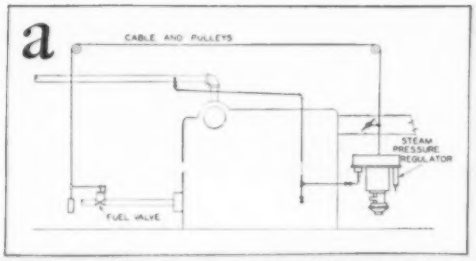


Fig. 1. Simplest positioning control has a single regulator with a single boiler

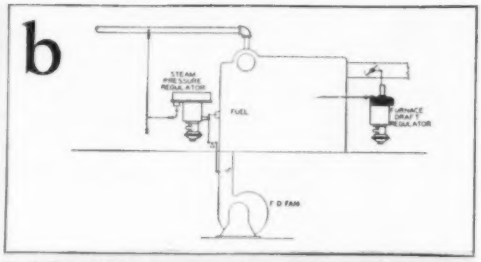


Fig. 2. The modified positioning control has two regulators with a single boiler

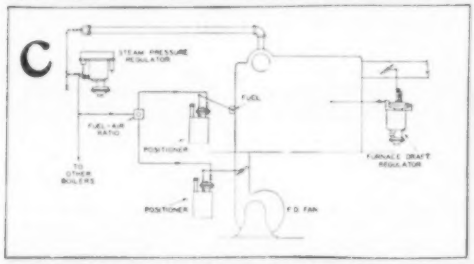


Fig 3. Control for several boilers requires the inclusion of a master regulator

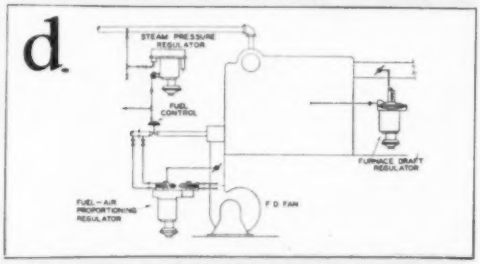


Fig. 4. The sequential control for multiple installations is based on fuel flow

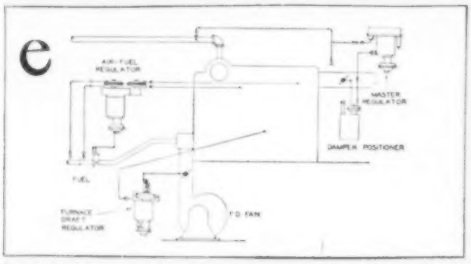


Fig. 5. Another sequential control, multiple installations, uses indirect air flow

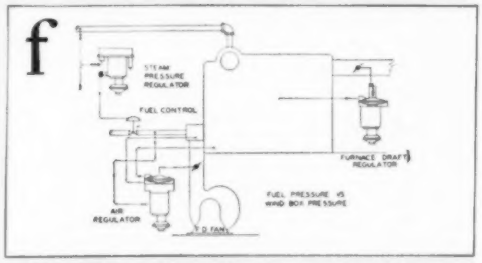


Fig. 6. A sequential control arranged for fuel pressure vs wind box pressure

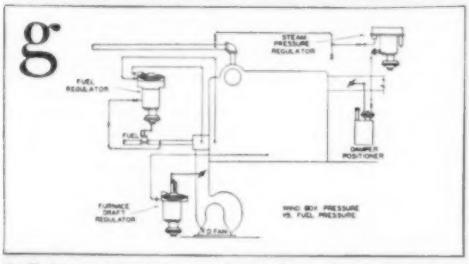


Fig. 7. A sequential control arranged for wind box pressure vs fuel pressure

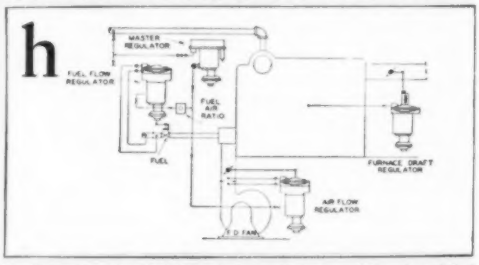


Fig. 8. Premetered control, for multiple installations, regulates air and fuel

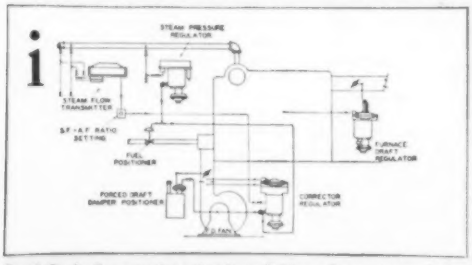


Fig 9. Combustion corrector system is a suitable one for one or more boilers

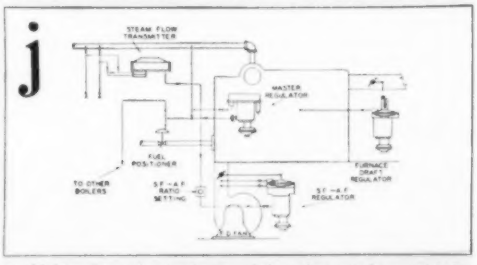


Fig. 10. Uncoordinated system has three independent controls on each boiler

Positioning Control (c): — Control for multiple boiler installations uses master regulator and two positioning regulators per boiler, with one fuel and forced draft. This system provides for manually setting fuel-air ratio, but depends on positioning of fuel and air controls with no check back to fuel or air measurements to assure constant efficiency or uniformity of results.

Sequential Control (d): — One type, with metered air and fuel, for multiple installations uses a master regulator with fuel-air proportioning and furnace draft regulators. This type has a tendency to smoke on increasing rating. Fuel flow must change before air flow can follow to satisfy combustion conditions.

Sequential Control (e): — Another system, with metered air and fuel, for multiple installations uses a master regulator, boiler damper positioner, an air-fuel proportioning and furnace draft regulators. This arrangement uses indirect air flow measurement provided by draft losses through boiler passages. Forced draft air is governed by furnace draft. There is a tendency to smoke on decreasing rating, since air flow must change before fuel flow can follow. A safety factor is provided because fuel follows boiler draft loss and thus control prevents overloading of the furnace with fuel.

Sequential Control (f): — System has pressure check back for fuel and air and can be arranged for fuel pressure versus wind box pressure.

Sequential Control (g): — Same system can be arranged for wind box pressure versus fuel pressure.

Premetered Control (h): — For multiple installations, the system uses master, fuel, air flow and furnace draft regulators. Fuel and air are controlled simultaneously by measuring regulators. A very satisfactory system, it is free from smoke and with fuel and air in proper ratio provides good boiler efficiency over a wide load range. Air flow measurement is taken in forced draft duct, free from all furnace disturbances.

Combustion Corrector (i): — For single or multiple boiler installations, this is really a positioning system with combustion correction using steam flow as an indirect measure of instantaneous Btu heat input to furnace. Steam-air flow relationship is the measure of combustion efficiency. The system produces simultaneous impulses to fuel and air with correction to maintain steam-air flow relationship constant. Effective when fuels are inconsistent, the system is seriously affected by feedwater disturbances.

A variation might be to locate the corrector regulator in the fuel circuit instead of in the air-flow master circuit. However, operation with such arrangements has not resulted in satisfactory combustion conditions, therefore the arrangement with the corrector regulator as shown in (i), Fig. 9, is preferred.

Uncoordinated System (j): — In this system there are three independent sets of controls on each boiler. Master control system regulates only the fuel. Air flow is controlled from steam flow only. Furnace draft control is also independent. This system works well when fuel is consistent, the number of burners is constant, and there are no serious feedwater disturbances.

Evaluation

Each type of control has its place in power plants. It cannot be said that any one system is universally better than any other. Before deciding which of the basic systems will give the most economical results for a given installation, it is necessary to study and evaluate several factors: size of boilers, load conditions, regulating characteristics of all auxiliaries (characteristic curves should be obtained), intelligence and attendance of operating personnel, money available, and returns expected from investment.

Final selection usually is governed by the operating characteristics of the controlled equipment, particularly the burners or fuel feeding mechanism, money available, and investment returns.

In order to obtain highest combustion efficiency from a boiler unit and control system, the basic plant equipment selected (fans, fuel burning equipment, pulverizers, etc.) must be of types that lend themselves readily to control. Complicated safety systems and combustion control systems should be avoided; the simplest systems give the best results. It is also important that good measurements for air, fuel and steam flow be provided.

The foregoing explanation of fundamentals was presented by the author in a Conference on Combustion at the University of Tennessee.

More Power For Greece

BY THE END of 1952, or soon thereafter, Greece will have a new steam power plant. The station is part of a program to help Greece attain adequate electric power facilities to meet all her needs, and is being financed by the Marshall Plan, the Greek government and others. Three hydroelectric plants are also in the construction program, as well as attendant transmission lines, substations and distribution systems.

Power developments in Greece have lagged far behind those of all Western nations, excepting Bulgaria, with electricity available only in the major cities and towns.

Construction of the new Aliveri thermal-electric station is the result of a complete survey of power resources and requirements of the Kingdom of Greece by Ebasco Services, Inc., at the request of the Greek government and the U. S. Economic Cooperation Administration. It was decided to develop lignite deposits in the vicinity of Aliveri on the Island of Euboea; to install modern mining and cleaning equipment; to build a modern central station; and to burn lignite from the cleaning plant. All fuels, except lignite, must be imported to Greece.

Aliveri is to be of outdoor construction, and will have two 30,000-kw turbine generators. There will be four steam generators, each producing 200,000 lb of steam per hr at 925 psi and 905 F at superheater outlet with 345 F feedwater at economizer outlet, 325 F combustion air temperature at the air heater outlet.

Each steam generator consists of a Babcock & Wilcox two-drum single-pass boiler with waterwalls, superheater, continuous tube economizer and tubular air heater. Multiclone cinder separators will be installed between boiler exit and economizer inlet.

To burn the low-grade lignit available to the plant from the "captive" field being developed simultaneously, four Detroit RotoGrate stokers were chosen. Each stoker unit is approximately 32-ft wide and 18-ft long between shaft centers, and each will have 8 fuel-feeding rotors.

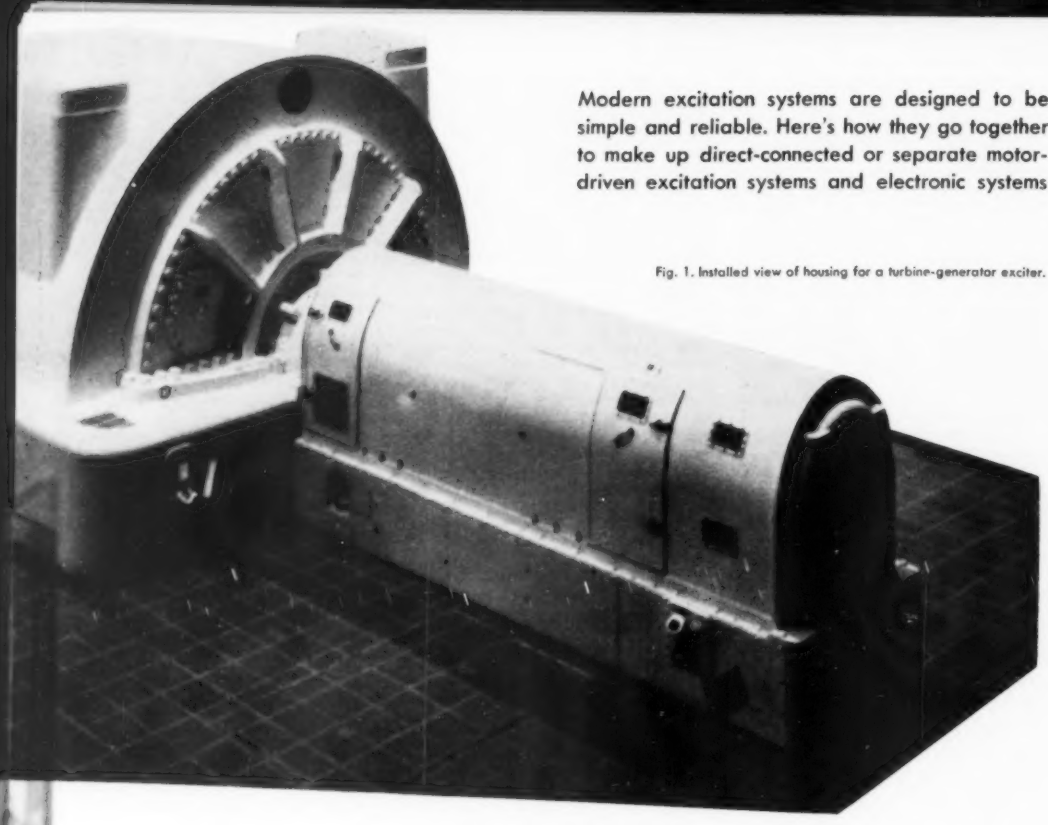
Sample analyses of the lignite show the following minimum characteristics: 35 per cent water, 24 per cent volatile matter, 16 per cent free carbon, 25 per cent ash and 0.8 per cent sulfur. Ash fusion temperature is 2140 F and Btu per lb is approximately 5000 minimum. Oil burners will be installed for use only in emergencies, since the importation of fuel oil is necessary.

Over-all efficiency of the plant is expected to vary between 74.2 and 76.7 per cent depending upon the fuel.

Detailed plant design is under the supervision of Burns & Roe, Inc.

Correction Note:— 13th Annual Water Conference

IN THE ANNOUNCEMENT of the Thirteenth Annual Water Conference, page 77, July 1952 issue, the title of the Monday morning paper by S. B. Applebaum should have read Experiences with Chloride Anion Exchangers for Reducing Alkalinity *Without* Acid (instead of *with* acid as we had it). The word *without* happens to be a very crucial word, because the point is that you do not use acid when you use the chloride anion exchanger process, according to Mr. Applebaum. Our faces are very red.



Modern excitation systems are designed to be simple and reliable. Here's how they go together to make up direct-connected or separate motor-driven excitation systems and electronic systems

Fig. 1. Installed view of housing for a turbine-generator exciter.

Excitation Systems

TWO FEATURES of paramount importance in excitation system design are reliability and simplicity. These have been stressed because of the complete dependence of successful operation of a synchronous machine on its excitation system. The consequences of a failure in the supply of field current to an a-c machine are major, and equipment or combinations of equipment that will not fulfill these primary requirements cannot be safely applied.

The modern excitation system, although relatively simple, consists of a number of separate equipments. Most systems will consist of an exciter, a voltage regulator, an exciter field rheostat, a field discharge resistor, a field switch in the main generator or in the exciter field circuit, and other miscellaneous devices employed for metering or alarm purposes.

This equipment is very often mounted in locations convenient to the general plant construction plan. There is, however, a very definite trend toward a factory-built equipment containing all the parts necessary for a complete excitation system. This equipment is known as an excitation or field cubicle.

Size and type of the equipment involved is largely determined by size of main generating unit. The new large turbine-generators have required an excitation system capable of supplying a main field current of more than 1500 amp. Hydroelectric units have required higher currents.

Field Voltages

Two field voltages have had acceptance as standards throughout the industry: 125 v for small machines and 250 v for larger machines. With development of the new high-speed turbine generator with a capacity exceeding 100,000 kw, it has been found advantageous to design the field for 375 v. The higher field voltage reduces the size of all current-carrying parts. It also reduces the cross-sectional area of the field turns, with resultant ease in assembly of field coils in the main generator.

Some years ago it was common practice to supply field current to a number of machines from an excitation bus, to which one or more direct-current exciters were connected. Excitation control was normally manual and a main field rheostat was connected in series with the field of each synchronous machine supplied from the bus. The rheostats made it possible to control field current of each machine independently, even though all machines were supplied from a constant potential source. A stable excitation system was also provided, since the field current of any machine could be reduced to low values by means of its rheostat with the rotating d-c generator or exciter maintained at a high, stable voltage.

These main field rheostats were bulky and expensive, since a current carrying capacity equal to the full-load field current of the main machine was required. In addition, the interconnections between the field windings of several main machines were undesirable from the standpoint that a failure in the excitation system might shut down the entire plant. Complications in the connection of the field and exciter switches gave rise to the possibility of opening one of the switches without adequately

By S. R. FOLGER
Central Station Engineering Divisions
General Electric Co.

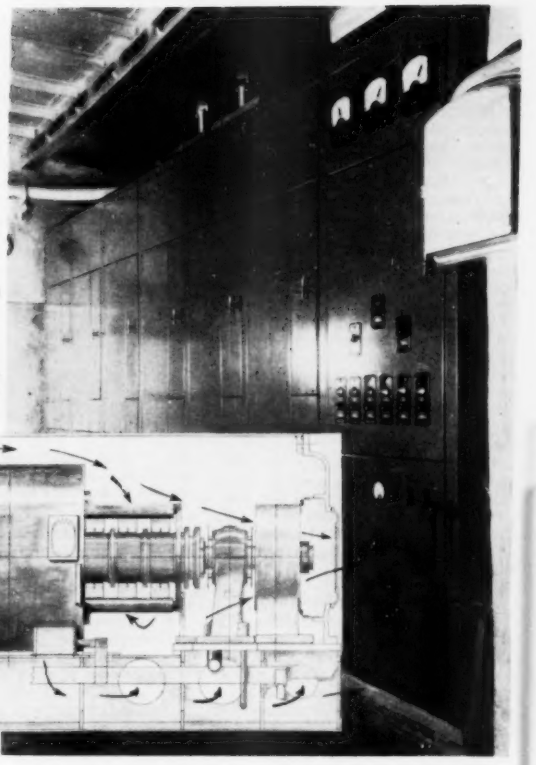


Fig. 2. Exterior view of electronic exciter in enclosing case

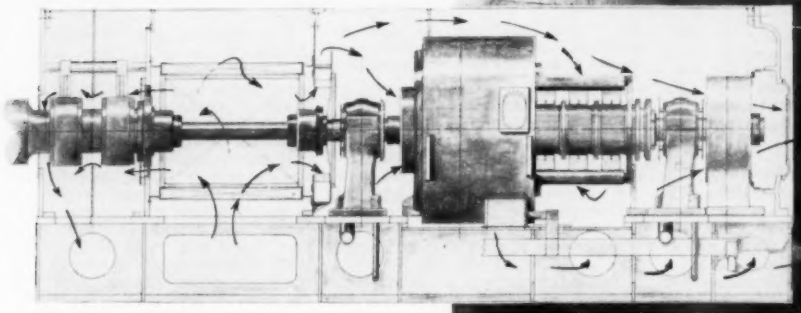


Fig. 3. Shaded left-side elevation of large direct-connected exciter for turbine-generator excitation. Arrows show flow of ventilating air

—1952 Style

protecting the main machine fields from overvoltage.

Present installations use the unit scheme, with an exciter for each synchronous machine. A spare exciter may or may not be present. The switching arrangements are such that, except during transfer, only one field switch is closed at any one time. With elimination of the main field rheostat, it was necessary to stabilize self-excited exciters down to the low values of excitation that might be required. All self-excited main exciters are now designed so that the saturation curve bends over at a low value of voltage and thus provides a sharp intersection of the saturation curve with the field resistance line at low voltages.

Except in the special case where a synchronous machine must carry the charging current for a long unloaded line, the minimum stable exciter voltage required is usually that voltage necessary for synchronizing. This is, of course, no-load excitation. In the rare circumstance where the exciter voltage must be reduced below its minimum stabilized voltage for line charging, this can usually be done by means of certain external connections in the exciter field circuit.

Types of Exciters

With the changeover from the exciter bus to the unit excitation scheme, the pilot exciter came to the fore as a better and less expensive method than the main field rheostat of providing exciter stability at low values of excitation. Later development of the stabilized exciter permitted use of an exciter without either a main field rheostat or a pilot; and this has become the most modern of present excitation systems.

The modern exciter can be supplied direct-connected, geared, or separately driven. If a pilot is desired, it can be direct connected to the main exciter. There are many individual preferences in the type of exciter drive. The most popular are the direct drive and the separate motor drive. Preference is shown to the former because of the complete reliability of the driving means.

The geared exciter has been used for many years with a gear ratio to about 1800 rpm. Large exciters have also been geared to about 1200 rpm. However, with the development of the new high-speed exciter, application of the geared exciter has become infrequent. It is now possible to direct connect exciters to the larger 3600-rpm machines. The complete line of Preferred Standard turbine generators rated 3600 rpm can be supplied with direct-connected exciters.

Overhung exciters are applied to 1800-rpm machines in all the small sizes. Larger 1800-rpm exciters, as well as all of the 3600-rpm exciters, are two-bearing machines.

DON'T CLIP THIS ARTICLE

Others in your plant may want to read the complete issue, so if you want an extra copy of this or any other article, ask the Editor for tear sheets or a reprint. For convenience, use the postage-free card that you will find elsewhere in this issue.

Special features are applied to the high-speed exciters to make them as near maintenance-free as possible and to provide the best over-all performance. Figure 3 shows how ventilating air for the exciter is drawn into the housing through a filter. The air flow is then divided into a double flow, part of the flow passing through the windings and the other part passing by the commutator. Air from the commutator is discharged from the housing and thus never passes through the windings, hence the latter are maintained free from carbon dust. Positive air pressure is maintained at the bearings at all times, to exclude oil vapor from the ventilating air.

Commutator bars are held in place by means of spring rings. These absorb the expansion or contraction due to temperature changes, and maintain constant pressure at all times on the commutators. Loose or warped bars are thus avoided.

Direct-connected exciters are connected to the main generator by a double flexible coupling. This effectively isolates the exciter shaft from the generator shaft and thus prohibits transfer of vibrations from one shaft to the other.

Motor-driven Exciters

A special line of motor-driven exciters is available. These are generally 1200-rpm machines, although some of the larger sizes are run at 900-rpm. They are designed to take the place of the direct-connected or geared exciter and are so constructed that their performance, both mechanical and electrical, is equivalent to that of the direct-connected exciter.

Several advantages accrue from the use of these motor-driven sets. Length of the main turbine generator can be reduced by use of a motor-driven exciter, which can be mounted at some convenient location in the plant. When used with a spare, this exciter can be readily taken out of service for maintenance.

The motor-driven exciter shows particular advantages when used with the cross-compound turbine generator. The characteristics of the latter are such that at starting there is insufficient torque obtained from the steam flow to roll the low-pressure machine. If excitation is applied to both high- and low-pressure elements, however, the rotors will come up to speed together, the high-pressure generator actually driving the low-pressure generator as a motor. For this starting condition, a separate exciter set must be employed.

Preheating of large turbine generator fields has been recommended to relieve the friction forces in the insulation and the compressive forces in the conductors when the field becomes heated under high centrifugal forces. This can be accomplished, in general, by passing about 85 per cent rated field current through the field at low speed during the starting cycle. Since this current cannot be obtained from a direct-connected exciter at low speed, a motor-driven set is used for this purpose.

Such features as double-flow ventilation and the spring-back commutator, which are included in direct-connected and geared exciters, are also included in the motor-driven sets.

In order that this set may operate satisfactorily through major system disturbances, a flywheel is mounted on the shaft and the motor is designed for high torque. Sufficient inertia and torque are provided so that with a three-phase fault at the terminals of the synchronous machine for not over $\frac{1}{4}$ sec (one-quarter of one second) the speed of the set will not drop below the point at which 120 per cent of rated exciter voltage can be developed, and also the point at which the set will accelerate with the exciter voltage at this value when at least 70 per cent voltage is restored to the motor terminals following clearing of the fault.

Fig. 4. Motor-driven exciter set. Access to brushes and commutator at left; exciter and flywheel in center; induction motor at far end

Inertia of the set is such that, at full load, the throw-over time of the motor from one energized auxiliary bus to another can be as long as 4 sec when the voltage to which the motor is thrown over is at least 70 per cent of the motor rated voltage.

When a spare exciter is required, either the high-inertia motor-generator set, or a standard motor-generator set that does not meet the same rigid electrical and mechanical specifications as the above, can be applied. Choice between these two must be based on a consideration of the degree of reliability required.

Electronic Exciters

Electronic exciters have sometimes been applied in lieu of the rotating exciter. The electronic exciter, Fig. 3, consists of a power tube rectifier with the required control equipment and the supply transformer. Field current is supplied to the synchronous machine through anode contactors, which serve as main field switches. The equipment is designed to stand the loss of any one power tube without affecting the excitation supplied to the synchronous machine. A tube can be simply changed during operation by opening the anode contactor involved.

Power for this exciter is commonly obtained from an auxiliary station bus. Although the auxiliary bus voltage is not usually maintained during a fault condition on the main generator, the rapid response of high-ceiling electronic circuits, when the voltage is restored, provides an excitation system with excellent overall performance. Use of a shaft-driven a-c generator on the main set has sometimes been considered. This, however, again adds most of the structural disadvantages of the normal direct-connected exciter, with very considerable additional expense.

Another article in a subsequent issue will describe in detail just how voltage regulators control automatically the excitation systems of large a-c generators and synchronous condensers. That article will show how the regulators work and how they are made. To follow that, a third article will take up field switches and rheostats, meters and relays, excitation cubicles and excitation system layout.

How to Make and Use Lignum Vitae Bearings

By ROBERT F. CLOTHIER

LIGNUM VITAE, sometimes known as ironwood is a very heavy, durable wood, native to the tropical Americas and the West Indies. It is a wood that for many years proved to be a satisfactory material for bearings. Strange as it may seem, this fact has apparently been forgotten for the past two or three decades. It wasn't until shortages of bearing materials, such as tin and lead, occurred during World War II that lignum vitae was recalled to use.

Physically, it is the heaviest wood. Its average density, 83 lb per cu ft, is nearly identical with that of limestone or bituminous coal. The outstanding characteristics of lignum vitae that make it a suitable bearing material are: its high density, which enables it to withstand great loads without crushing; and its high gum content, which makes it naturally slippery. In fact, when the wood is dry, it has a soapy feeling. The only substance necessary to increase this natural anti-friction property is water. No coils or other lubricants need be used.

Years ago, lignum vitae was used in many places as shaft bearings; for example, on water-wheel generators and on the propellor shaft outboard bearing on ships. Nowadays, attention is being called to it again because it can be readily used in cases where certain bearing metals may be in short supply.

Lubrication

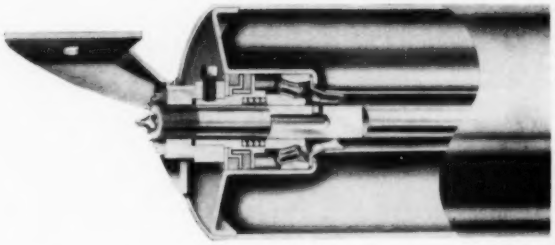


Fig. 1. Section of a belt conveyor carrying idler, showing grease seals and lubricating duct. Entire chamber and inner tube are filled with lubricant when shipped by the manufacturer and ordinarily no additional grease is required for two years

Adds to Conveyor Life

Proper lubricants used at correct time and place and in correct amount will lengthen the life of your power plant conveyors. The author, drawing from his vast experience in this subject, tells you how to do this

By WILBUR G. HUDSON

THE MANAGEMENT OF A PLANT using extensive materials handling units is naturally keenly interested in their maintenance. One factor involved is proper lubrication — both in quantity and quality. Some are carefully tended, some are not.

Probably the conveyor with the most serious risk of costly damage from improper lubrication is the belt conveyor. If a carrying idler should stick it requires but a few hours for the underside of the belt to become damaged, and if eventually the roll shell should cut through, there is real trouble. Usually there is no indication of what is happening along the line. The added pull on the motor is not sufficient to trip the overload relay. However with the modern anti-friction idler bearings, a stuck idler is a rare occurrence.

Trouble comes more frequently from over-lubrication than from lack of it. Bearings packed with lubricant by the manufacturer and, with the modern labyrinth dust seals, need no further lubricant for two or three years. It is difficult to impress this fact on the average attendant and if he makes the rounds every month or two with a forced-feed grease gun, the labyrinth seals are ruined. The exuded grease coats the underside of the belt and soon the rubber and the belt edges rot. Some of the synthetics (Neoprene, etc.) resist this degradation.

Years ago an interesting test on a coal-handling installation for the Philadelphia Electric Co. was made. The lubricating ducts of a few of the sets were soldered up so no fresh lubricant could be injected. It was the intention to check the results at intervals, but the matter was forgotten for ten years. Finally the sealed idlers were dismantled. The bearings were in good condition and the original grease was hardly discolored. Today, grease seals are far better than we had then.

Tripper pulley bearings should be anti-friction type to eliminate the probability of a stuck pulley. There have been instances where sleeve type tripper bearings have stuck and the tripper surged forward at belt speed to wreck the take-up assembly and damage the belt.

Attention to Adjustment

The most important factor bearing on long life is attention to adjustment of idlers so the belt runs central. Some of the long belts, now made possible by wire cables in the carcass, represent an investment of $300,000.

Screw-conveyor lubrication is a relatively simple matter unless the material handled is such that it must not come in contact with the lubricant, as for example, table salt, face powders, and food products. In such cases it may be better to use oil-impregnated bearings in the intermediate hangers. If the material has a high temperature, white iron bearings are advisable. If the material is actively abrasive, light loading is important so that it does not come in contact with the hanger bearings.

Some long conveyors for unit loads have closely-spaced rollers on which the carrying platen moves along slowly, as for example conveyors for coiled strip steel which must be cooled sufficiently to permit the lift-off magnet to function. It is essential that no lubricant vapor should come in contact with the hot strip because discoloration results. There are several automatic lubrication systems available. These have a small oil pump with timed stroke connected to a duct with branch tubes leading to the bearings of the rollers. At suitable intervals a measured amount of lubricant is injected into all bearings. This eliminates the nuisance of attending manually to each of the many bearings and assures just the right amount of lubricant to each.

Heavy-duty chain conveyors, pivoted bucket carriers, etc., usually have mid-pitch carrying idlers mounted on sealed anti-friction bearings. With highly abrasive pulverized materials, parts in sliding contact (rollers and bushings) cannot stand up. On one pivoted bucket carrier installation handling highly abrasive alumina dust, no lubrication was permitted other than the original packing of the bearings. The assembly of the mid-pitch carrying rollers is shown in Fig. 2. After six months operation, 24 hours per day, the 1-in. pins showed the diameter reduced to 0.98-in. under the roller bearings and to 0.981-in. under the two felt seals. The grease and dust formed a good grinding compound. Life would have been short with unprotected plain bearing rollers.

Continuous-flow elevators have the chain embedded in the material so lubrication is impossible. However these are not intended for handling

abrasives so the material itself may serve as a lubricant. Typical of "self-lubricating" materials are, bran, chalk, flake graphite, copra meal and soybean meal.

Abrasive Materials

Sometimes trouble arises from an unexpected source. At a Milwaukee brewery a small elevator was installed for hot "brewers grains," an innocent-appearing material resembling breakfast oatmeal. An inspection after two months showed that the malleable iron chain pins were badly corroded. The plant chemist blandly commented that he had neglected to mention that the lactic acid in the hot grains had a very active corrosive action. A stainless steel chain would have stood up but he considered it cheaper to replace the malleable chain from time to time.

Metallic dusts often are troublesome. These work into the chain and stiffen the joints so the chain cannot articulate. Abrasives such as aluminum oxide, cullet, molybdenum concentrates, silica flour, and the like soon terminate the active life of a continuous-flow elevator.

The skip hoist is a rugged machine that stands up for years with minimum maintenance if the sheave diameters have a diameter ratio of not less than 30 to 1 compared with the cable diameter, if their grooves are the proper shape, and if the wire rope is suitably lubricated. Its failure probably means the wrecking of the automatic loader and its supports.

Individual wires of a steel cable move relatively to each other and twist around their own axes. Protection of these surfaces from rust and wear by lubrication is essential. Before applying a lubricant, dirt and grit should be removed by brushing with kerosene. Some lubricants have an acid base which actually corrodes wires. The lubricant should be one which will not fight with the lubricant already on the cable. Since it is difficult to determine the condition of a cable by surface inspection, it is well to play safe and install a new cable or reverse the cable when gradual elongation ceases. Many operators determine the condition of the cable from tonnage handled as well as by inspection.

The costly high-speed drive chains (silent chain, precision roller chain) call for careful attention to lubrication. Usually they are protected by an oil-proof casing and lubrication often may be automatic by having the chain dip into a lubricant pool at the lower end of the drive. If necessary, a circulation of oil may be had by pumping from the casing pool directly into the links as they enter the drive sprocket. Each manufacturer of these precision chains maintains a research laboratory to determine the best quality of lubricant for their chains and their advice should be solicited. It is not unusual for a chain drive properly aligned and lubricated to have a life of 20 years or more.

The long-pitch, slow-speed conveyor and elevator chains may have grease ducts leading in from the ends of the pins, assuring that the lubricant gets into the parts needing lubrication and the excess will maintain a protecting grease collar at the ends. With chains exposed to abrasive dust it may be best to run the chain dry, letting the dust work into and out of the contacting surfaces rather than forming a retained cutting compound in the bearing.

Lubrication Protects What?

In any discussion of lubrication it is desirable to know just what we are guarding against. There may be abrasion, corrosion, erosion, or galling. Just what is the difference in these?

Abrasion is the cutting or wearing away of one material by another. A resilient material like rubber, or a soft material like lead or copper may resist impact abrasion better than a hard material. In a pneumatic con-

(*Continued on page 106*)

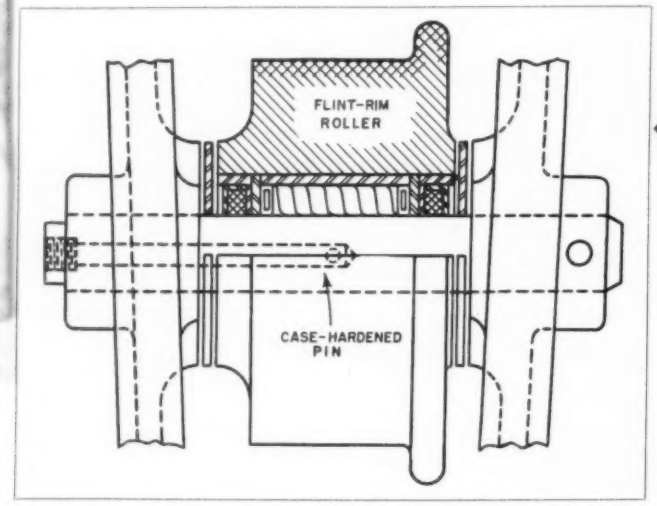
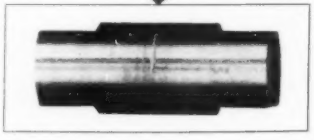


Fig. 2. Mid-pitch chain roller of pivoted bucket carrier designed for handling material in an atmosphere of abrasive dust. Roller is carried on spiral-wound bearings, which tend to carry the grease outward. There are felt seals at each end

Fig. 3. Two-inch chain pin subjected to test by the U. S. Engineers. Galling is just starting near the center. A pin of similar composition with a coating of 0.0003 in. cadmium resisted galling at 25,000 psi, which was the entire limit of the testing machine



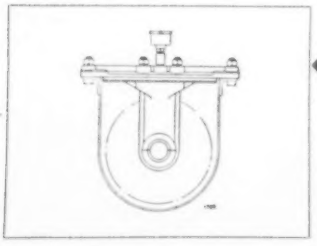
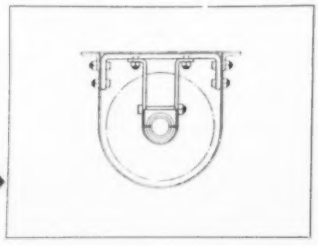
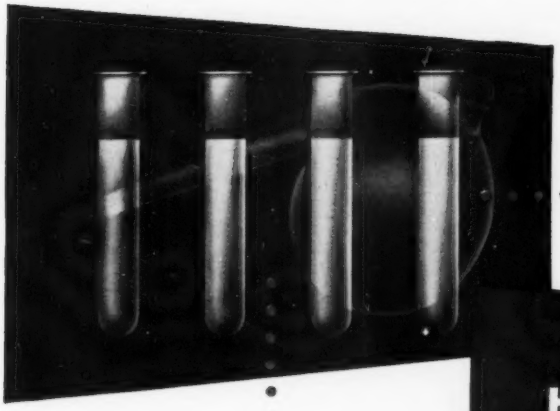
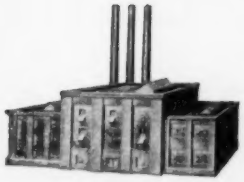


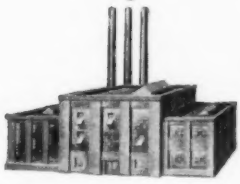
Fig. 4. Typical screw conveyor intermediate hanger bearing. Grease lubricated bearings used

Fig. 5. Removable white iron bearings, non-lubricated, intended for conveyors handling heavy and abrasive materials similar to cement









Here's a sure way to control carryover and blowdown

Impure steam and excessive blowdown are two "bugaboos" that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a large midwestern plant operated at 250 pounds pressure and used boiler feedwater softened by the hot lime soda process. The river water used as make-up at this plant varied widely in composition and was contaminated by a number of industrial wastes. Highly impure steam was produced with boiler water concentrations of approximately 3,000 ppm.

After analysis, Betz Engineers applied properly formulated anti-foam agents to this problem. Boiler water concentrations were raised to the extremely high value of 16,000 ppm before a similar steam impurity developed!

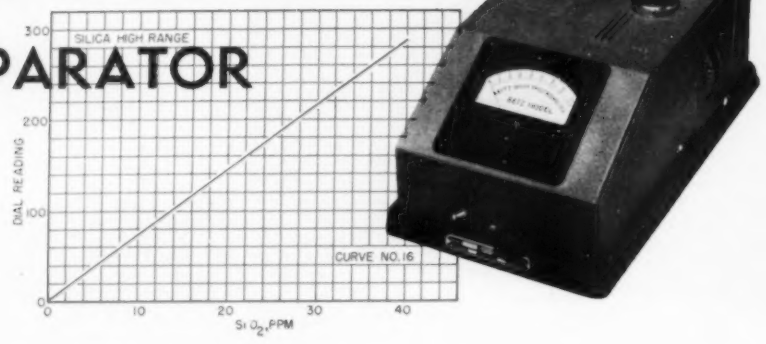
The positive control of carryover and boiler blowdown is only one of the many services extended by the Betz Organization. Let us explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

PHOTOELECTRIC COMPARATOR



Gives Precise Water Analysis

CONTROL ANALYSES used to govern treatment of water for industrial purposes are usually based on a colorimetric titration — the comparison of colors developed upon addition of certain reagents to the water sample. As water treatment problems and methods for their solution have grown more complex, there has arisen a need for increasingly more accurate analytical determinations — not only in laboratory and research analysis — but in routine plant control, according to *The Betz Indicator*.

Unlike analysis of many materials, where constituents are expressed in percentage and accuracy of 0.1 per cent is satisfactory, water analysis frequently must be expressed exactly to within 0.01 ppm, equivalent to 0.000001 per cent. Consequently, in order to determine such low concentrations, it has been necessary to develop very accurate methods of water analysis.

One of the most useful tools available in the search for more sensitive techniques is the photoelectric comparator (i.e. photoelectric colorimeter or photometer), shown above. A photoelectric comparator can distinguish differences in color intensity not apparent to the human eye, and can consistently provide a reliable, reproducible reading. In addition, it can measure light absorption in ultraviolet and infrared ranges, not visible to the human eye.

Table I shows the approximate relation of wave length and color. Approximations are used only because of the variations in the human eye, and because the transition from one color to another is gradual, not abrupt.

How Comparators Work

Photoelectric comparators operate by reacting to the unabsorbed light which has passed through a solution in an absorption cell, and which strikes a photocell. Light is transformed by the photocell into an electric current which is proportional to the intensity of the light. This current is measured by a micro-ammeter, as shown in Fig. 1. The dial reading obtained is proportional to the intensity of the color in the solution, which in turn is proportional to the concentration of the ion being measured, for those solutions satisfying Beer's Law.

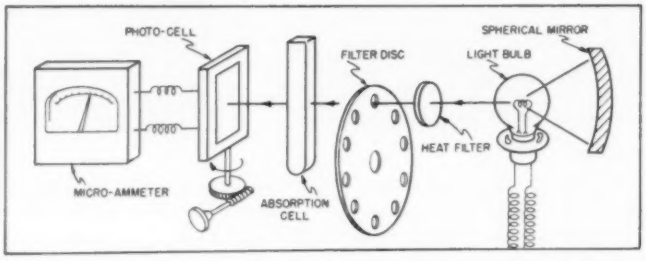


Fig. 1. Intensity of light, first filtered for heat and desired wave length, passed through an absorption cell is next transformed by a photocell to an electric current which is then measured by a micro-ammeter

Theoretically, monochromatic light or light of one wave length should be used. Spectrophotometers, which produce nearly monochromatic light, are normally too expensive and fragile. Instead, filter photometers, which pass light in a narrow range of the wave length, are satisfactory. Table II shows the peak transmission value and effective width at 50 per cent transmission of the 10 filters supplied with the Betz Model Photrometer.

The practical result of Beer's Law, which applies completely only where monochromatic light is used and which states that the absorptive capacity of a solution is proportional to the concentration of the ion in solution, is that when the concentration of an ion is plotted against the logarithm of transmittancy a straight line is obtained. The chart, above, illustrates a calibration curve for the determination of silica with a photoelectric comparator equipped with a logarithmic scale. The straight line calibration is consistent with Beer's Law.

(Continued on page 110)

Table I. Approximate relationship of wave length and color within the normal range of the human eye

Color	Wavelength, m mu
Red	620–750
Orange	600–620
Yellow	570–600
Green	510–570
Blue Green	490–510
Blue	430–490
Violet	400–430

Table II. Peak transmission value and effective width of the 10 filters with Betz photrometer

Peak Transmission m mu	Effective Width m mu
415	77
445	54
460	54
490	54
520	57
535	57
550	45
580	44
610	38
640	40

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Be prepared for winter. Equip every unit heater *now* with a Super-Silvertop Steam Trap. These traps quickly remove the cold, dead air from the core of unit heaters and permit them to fill up in much less time with hot, dry steam. Then by draining all water and condensate out of the coils, Super Silvertops enable heaters to produce maximum heat. Besides, they guard unit heaters against corrosion from moisture. Super Silvertops save enough fuel to more than pay for themselves by winter's end!

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LETTERS TO THE EDITORS

Power Plant Design

I AGREE with your correspondent, Howard T. Livingston, not so particularly on the piping (March issue, page 55), but that more detail about these new power plants would be interesting and helpful to us who are in the business of designing them. For instance, on the E. M. Poston Station, floor plans and a plot plan showing location of cooling towers and size of coal storage area with stocking out and reclaiming facilities would have been of interest.

To get to the main purpose of this letter, I think F. L. Bradley will have some valuable pointers on preventive maintenance (Simple Power Plant Design Aids Preventive Maintenance, March issue, page 76) but I feel he is getting off to a poor start on economical supply of steam and power in an industrial pulverized-coal station with condensing turbines, unless his hot water requirements are much higher than normal. Recent developments make installation cost for pulverized-coal equipment and ash disposal too high for competitive types of equipment, such as spreader stokers; and between fixed charges on initial cost and cost of attendance, it is difficult for the isolated plant to compete with purchased power.

While this probably does not affect Mr. Bradley's installation, presumably already built, it is difficult for the average business to dig up the cost of a new efficient power plant when the money could be so much more profitably employed in expanding manufacturing facilities.

Increase in cost of equipment and labor ratio since the end of the war have put by-product power in a tight spot as compared with substantially stationary purchased-power rates. It is only in quite large plants, with relatively high load factors and a reasonable excess of steam demand above power demand, that we have a chance to build a complete industrial power plant.

New Haven, Conn. H. D. FISHER

Editor's Note: — Mr. Fisher may be right. Nevertheless, we have just counted up some 70 industrial companies that have installed in 1951 or are planning to install turbine generators in 1952, ranging in capacity from 750 kw up to 60,000 kw. In addition, at least 40 municipal steam power plants are installing condensing turbine generators in the years 1951, 1952, 1953.

Our observation is that Mr. Fisher's qualification "with high load factors and a reasonable excess of steam demand above power demand" is the governing factor and that there seem to be still a good many industries in which this condition is true, despite increases in electrically-driven equipment.

Boiler Setting Expansion

An article, Let Your Boiler Setting Walls Expand Vertically, by H. D. Fisher, appeared on page 88, June issue.

Mr. Fisher brings out a number of valuable thoughts on which I concur. However, I do not believe he has gone far enough in his article; he has not dwelt sufficiently on a few of the practical angles.

For instance, if a combustible filler were placed beneath the header courses of the inner 9 in. of refractories and this filler burned out, the wall would be top heavy and lean inward, since 8 in. of red brick could not possibly sustain the cantilever weight of 9 in. of refractories.

For the wall to be stable would mean the outer red brick wall be at least three courses in width. The refractories, unfortunately, not only must expand upward, but in all other directions as well, so provisions must be made to let them expand in all directions.

Mr. Fisher shows temperature gradient through the walls, but he does not show an expansion curve of the refractories at the different temperatures. This is rather difficult to do because of the many different kinds of fire brick that could be used.

In the majority of our Missouri refractories, the maximum amount of expansion would occur at temperatures of 1800 to 2100 F, depending upon not only the particular brick, the type of burn, but also upon superimposed loads. Thus, with the average refractory your maximum expansion would occur well within the walls.

The Detroit Edison Co. some years ago found that the maximum expansion occurred from 2 in. to 6½ in. from the inner face of the refractories, depending principally upon the amount of superimposed load and whether or not the walls were insulated.

It is a very good idea to separate the wall into series of units by the use of combustible fillers and transfer the weight to the rear or cooler portions of the walls. In doing this the average temperature at which the fire brick will soften and deform is from 200 F to 400 F, higher than if the wall was not separated into units. This feature is 90 per cent of the advantage in sectionally-supported walls.

In sectionally-supported walls, however, instead of using a single course of brick as a header to transfer this load to the red brick, suspended walls use castings to transfer the weight of the refractories to a supported metal framework.

The writer has written several articles on this subject, one of which appeared in the May 1944 issue of *Power Plant Engineering;* another in July 1945, and one in November 1947.

Kansas City, Mo. GEO. P. REINTJES

Color in Power Plants

STANDARDIZATION of colors can be used to advantage by maintenance supervisors in utility and industrial power plants in assuring good paint coverage each repaint period. One utility paints its steel towers and similar equipment a different color each time these structures are painted, say every five years. The first time, the color universally used was aluminum. Next painting of these same items was in green. This will be followed by yellow and so on.

In this way, an automatic record is maintained of the year of the last painting of that particular piece of equipment. They can detect any towers or equipment that may have been missed. Inspection of the work of the painters is simplified by the ability to quickly discover unpainted areas. It helps the painters in giving good coverage.

Painting aluminum over aluminum makes close inspection difficult. When green is painted over aluminum, towers can be inspected with field glasses or even without them. The work of various contractors can be more readily evaluated by varying the colors as a standard practice.

Undoubtedly many other applications of color can be made by maintenance departments of plants to save labor and materials, and to do a better job.

Ohio L. G. JONES

Editor's Note: — Here is a maintenance idea that deserves as much attention in the power plant as it has attracted in some industrial plants where it has been tried.

The modern power plant is usually a very colorful place, especially the utility plants. But rotation of colors, for the reasons given by Mr. Jones, has not been tried so often.

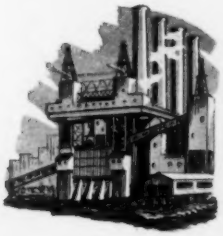
In a series of short articles soon to be published, Mr. Jones will give you some intensely practical help on all phases of modern power plant painting — how to test and buy paint, how to use it, color as an industrial relations aid and so on.

Do You Want To Be a Technical Editor?

WE ARE still in the market for a qualified assistant editor for POWER ENGINEERING, as detailed in the July and August issues. He should be 25 to 35 years old, should have at least 2 or 3 years of practical power plant work, plus some mechanical or electrical education. Write the Editor.

UNSURPASSED

in the Power Field



W-S FORGED STEEL FITTINGS

Screw-End and Socket-Weld Types

Since Watson-Stillman engineers first developed their special line of forged steel fittings to meet the service conditions of the Power Field, the W-S double-diamond trade-marked fitting has been identified with longer, more dependable life and lowest per-year cost in all phases of the industry's operations.

Precision-machined from solid drop-forged steel bodies, Watson-Stillman fittings are much less subject to unscheduled outages than fittings made from other materials or by other methods of fabrication. Being stronger, they are much smaller and lighter . . . bringing economies in weight and space all the way down the line. Their denser, tougher metallic structure is more resistant to corrosion, vibration, shock, and all types of stresses—including internal pressure and creep—than other types.

Yes, there are many reasons why W-S double-diamond fittings are preferred by *all* industries. Want more information? See your Watson-Stillman distributor or write direct.

• Stronger • Smaller • Lighter • Tighter
• More Uniform • Lower Service Cost

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

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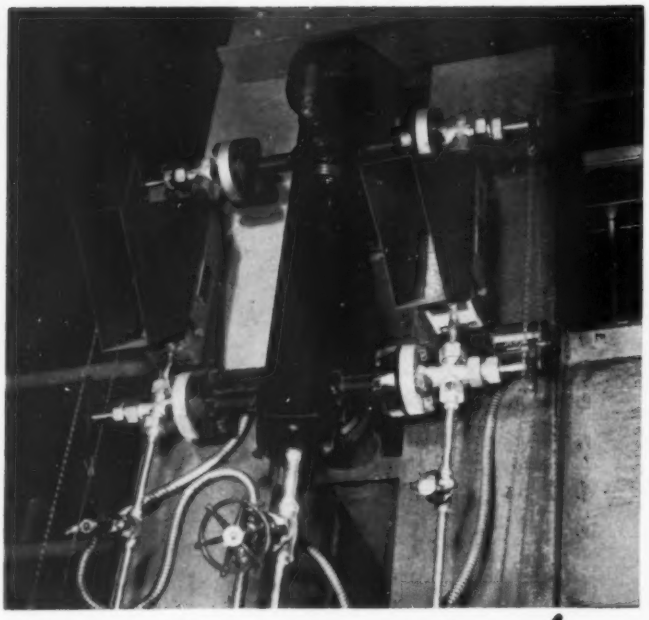
WATSON-STILLMAN
ESTABLISHED 1848

DISTRIBUTOR PRODUCTS DIVISION
ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Hand Pumps, Jacks, Wire Rope Shears, Pipe Benders and Hydraulic Equipment



Help yourself to *Better Water Level Supervision* with Reliance Boiler Water Columns

Assure *greater accuracy of gage readings . . .*

Have *safety warning by automatic alarms on pressures up to 900 lbs.*

Reliance Boiler Water Columns have unusual ruggedness, safety features, and extra capacity well above their ratings. For pressures to 900 lbs., the Reliance high and low ALARM Water Columns provide a reliable warning signal. Sensitive to the slightest water level variation.

Reliance Columns without alarms fill any requirement up to 2000 lbs., in standard models or special construction engineered to fit your needs.

Specializing for 68 years, Reliance brings you the most complete service in approved devices for water level supervision—water gages for water column installations — direct-to-drum gages — remote reading gages—special alarms for boilers and auxiliary tanks. Check with your consultants or ask for our nearest representative.

The Reliance Gauge Column Co.
5902 CARNEGIE AVE. • CLEVELAND 3, OHIO

The name that introduced safety water columns....in 1884

Reliance®
BOILER SAFETY DEVICES

SHAWNEE

(*Continued from page 76*)

heaters to insert additional elements to lower this temperature an additional 20 F if it is found advisable later.

Heat Cycle: — Each turbine exhausts into a 70,000-sq ft, single-pass condenser, which will condense 695,000 lb of steam per hr at 2-in. of mercury using 79 F cooling water. Seven stages of feedwater heating are used. The heat balance diagram, Fig. 4, shows that condensate pumps will pump through three low pressure heaters which will be installed in the condenser neck, then into the deaerating heater. From there boiler feed pumps will force the water through three high pressure heaters to the boiler.

The high pressure heaters have internal subcoolers which will reduce drain temperatures to within 10 F of incoming feedwater. These heaters are designed for a 0, +5 and +5 degree TTD for numbers 1, 2, and 3 heaters respectively. Three barrel-casing type boiler feed pumps, each rated 1102 gpm at 6140-ft head and 300 F water, are used for each unit with two capable of carrying the load. Calculated net plant heat rate (at capability rating and 1½-in. of mercury back pressure) of 9303 Btu per kwh place this plant among the leaders in the country in this respect.

Control Room: — As in previous plants a special effort was made to reduce the number of operators required. To this end, only one control room is provided for each of two complete generating units. All major mechanical and electrical control functions (except switching) are centralized in this room.

All engineering and construction work on Shawnee, and other plants of the Authority, is under the direction of C. E. Blee, Chief Engineer, R. A. Monroe, Chief Design Engineer, G. K. Leonard, Chief Construction Engineer, and J. S. Bowman, Chief Water Control Planning Engineer. All mechanical design is under the supervision of the writer.

CONVEYOR LUBRICATION

(*Continued from page 100*)

veyor a liner of lead in the elbows resists wear better than hard white iron.

Corrosion is a chemical attack on a metal or alloy. A common form is the rusting of iron or steel where oxygen in moist atmosphere attacks the surface. Corrosion is retarded by using an alloy resistant to attack, or by a coating of paint, lead, or by tinning or galvanizing.

Erosion is a wearing action by a stream of liquid or gas, as illustrated in the erosion of the nozzle of a steam jet conveyor by friction of the steam. Abrasion, corrosion, and erosion may occur simultaneously.

Galling differs from the above three. It is a tearing, possibly due to

FROM THE TOP STEEL PRODUCER . . .
TO A LEADING CHEMICAL HOUSE,
A YEAST COMPANY
AND A MEAT PACKER . . .

Heat Prover SERVES 62 DIFFERENT COMPANIES IN THE GREAT CHICAGO INDUSTRIAL AREA!

The Cities Service Heat Prover is graphically proving its worth to all kinds of industry in the Chicago area and elsewhere throughout the country.

62 different companies, producing everything from steel to beef, have found the Heat Prover an important aid to increased production and big dollar economy.

WHEREVER A FURNACE OPERATION IS INVOLVED, Heat Prover can help increase productivity by providing:

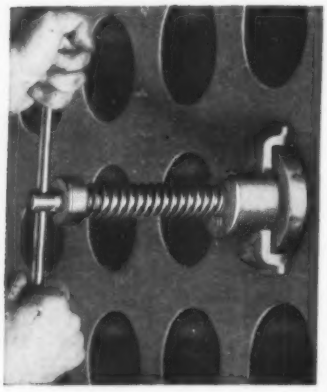
1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

REMEMBER: Heat Prover is not an instrument you buy but a service we supply. Contact the Cities Service office in your area and learn how Heat Prover can serve you . . . or write CITIES SERVICE OIL COMPANY, Dept. 123, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

48 man-hour job done in only 4 hours with a ROTO Hand-hole Seat Scraper



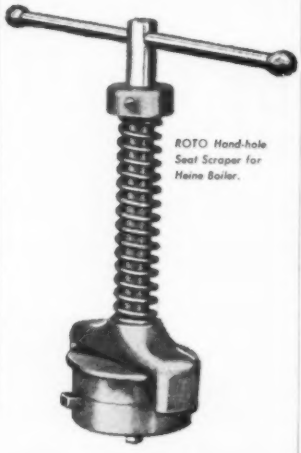
Illustrating ease of operation of Roto Hand-made Seat Scraper

If you operate any of the boilers listed below, you can't afford to be without a ROTO Hand-hole Seat Scraper.

A Pennsylvania manufacturer reports that it formerly took three men 2 to 3 days to clean inside cap seats on a Keeler Boiler header. Now, with a ROTO Hand-hole Seat Scraper, one man does it in four hours, besides doing a better job.

This simple, hand-operated tool is equipped with retractable knives mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Write for bulletin and prices.

MAKE OF BOILER	TUBE SIZE	OPENING
Babcock & Wilcox	4"	Oval
B. & W. No. 40 Header	3¼"	Oval
B. & W. No. 41 Header	2"	Oval
B. & W. Superheater	2"	Round
Babcock & Wilcox	4 13/16 x 5"	Square
Casey Hedges	4"	Oval
Casey Hedges	3½"	Oval
Combustion Engineer'g	3"	Round
Edge Moore	4"	Oval
Franklin	4"	Round
Geary	4"	Oval
Heine	3½"	Oval
Heine	3½"	Round
Keeler	4"	Round
Keeler	4"	Diamond
Murray	4"	Oval
Murray	3½"	Oval
Oil City	4"	Oval
Oil City	3½"	Oval
Union Iron Works	4"	Pear Shape
Walsh & Widener	4"	Oval



ROTO Hand-hole Seat Scraper for Heine Boiler.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue **Newark 1, N. J.**

atomic seizure, of the surfaces of two metals of the same or similar composition if the surfaces are clean and in direct contact. A slight film of lubricant, or two metals of different characteristics, eliminates the possibility of galling; thus a coating of 0.0003-in. of cadmium prevented galling, under pressures up to 25,000 psi of bearing area, of steels that otherwise galled at 2000 psi.

It is an old principle, still good, that one of two bearing surfaces should be as hard as possible. Tests of SAE 1040 bushings against SAE 1040 pins, both 250 Brinell, galled at 9000 psi. A combination of a Chapmanized — 1040 steel pin (high-nitrogen case of extreme hardness — 1000 Brinell) against an untreated 1040 bushing showed no galling at the limit of the machine — 19,000 psi.

A Chain Test

Some years ago the U. S. Engineers at Rock Island arsenal sought to determine the best make-up for the chains which would lift the heavy dam-control gates. As the chains are for the most part submerged in water, there could be no lubrication and the cleansed joints would be in the condition best suited to galling as the chain rounded the lift sprockets. None of the alloy steel pins tested successfully withstood pressures above 6000 psi. Pins with a thin coating of cadmium withstood galling up to the limit of the machine, in this case 25,000 psi.

The discussion has an application in connection with conveyor and elevator chains commonly used. For example, a popular chain is the so-called "rivetless chain," which has drop-forged steel links bearing against a drop-forged pin. These chains have enormous strength, but we cannot rate their performance on the basis of strength. Consider the 698 chain: the listed ultimate strength is 100,000 lb. With the usual $\frac{1}{6}$ factor it might be assumed suitable for a working load rating of 17,000 lb; but the pin has a bearing area in the center link, in which it articulates, of 1.125 by 1.56 in. and the pressure on the projected area of the pin would be 9,700 psi. The galling limit of forged steel against forged steel is about 3000 psi. Working backward, the working limit for this chain is 3000 × 1.75, or about 5250 lb. If there is a possibility that the bearing surfaces may at times be free of lubricant, that loading should not be exceeded or the pins will gall.

Some chains are called upon to operate under high temperature conditions, as in drying and annealing ovens. Cadmium plating is out because its strength drops off rapidly — in fact the metal melts at 610 F. A nickel-cadmium bearing metal containing upward of 3 per cent nickel has a strength of only 600 psi at 570 F, as contrasted with 14,000 psi at room temperatures.

However there are available heat resisting alloys of which the chain

It's better to get
all your valves
from ONE source
Because when you do this you avoid
— the confusion that accompanies stocking spare parts for valves of several different makes.
— the multiple stocking of valves and parts because different makes are not interchangeable.
— the needless complications that confront your maintenance department in making repairs.
— the chance that some valves are not backed by adequate manufacturer's engineering services.
The Powell Line is so complete that you can get all your valves from one source.
The Wm. Powell Co.
Cincinnati 22, Ohio
Fig. 18053 W. E. 600-pound Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant. Also made for 900, 1500, and 2500 W. S. P.
In the new Walter C. Beckjord Power Station of the Cincinnati Gas & Electric Co., Powell Cast Steel Pressure Seal Valves are installed in all high pressure-high temperature steam lines.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

Why you can place full confidence in **BOILER FEED PUMPS** by **Pacific**

IT'S A MATTER OF RECORD

That the availability for service of your boiler feed pump and the cost of maintaining it in top condition is determined by design . . . workmanship and materials of construction.

IT'S A MATTER OF RECORD

Pacific's designs provide the balanced proportions that insure mechanical strength . . . the simplicity of form that insures hydraulic efficiency . . . material efficiency . . . easy maintenance.

IT'S A MATTER OF RECORD

Pacific's precision workmanship provides . . . metal-to-metal sealing of internal joints to prevent water jetting from a high to a low pressure area . . . truly concentric shaft sleeves . . . close sliding fits, making it unnecessary to "shrink" impellers on the pump shaft.

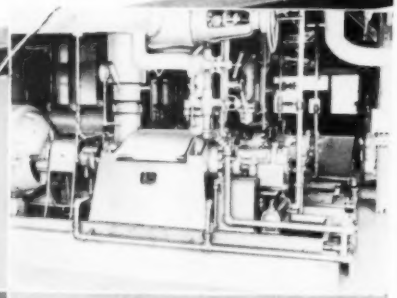
IT'S A MATTER OF RECORD

Pacific Boiler Feed Pumps are fabricated from materials carefully selected for specific functions . . . steel forgings for structural strength and stability . . . alloy steels for hardness . . . resistence to wear and to corrosion-erosion.

IT'S A MATTER OF RECORD

Pacific Multi-Stage Boiler Feed Pumps are built for capacities to 2700 G.P.M. . . . Discharge Pressures to 3000 psig . . . speeds to 5000 R.P.M. . . . Bulletin 109 for details.

Pacific Single Stage TURBOPUMPS are built for capacities to 1000 G.P.M. . . . Discharge Pressures to 1800 psig . . . Speeds to 10,000 R.P.M. . . . Bulletin 118 for details



PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

Offices in All Principal Cities

may be formed, such as one component of 35 per cent chrome and 15 per cent nickel bearing against a member of 15 per cent chrome and 35 per cent nickel. Lubrication that will withstand high temperatures is difficult. One of the best high-temperature lubricants is a black grease with a tallow base called Necrolene.

Two lubricators of interest, introduced recently, warrent investigation by those in a position to do so. In one the lubricating oil is atomized and the pressurized "oil mist" is tubed to all bearings as previously described. The manufacturers claim a substantial savings in the quantity of oil required and improved efficiency. The other is a lubricant with special applications for high temperatures and high pressures, sold under the name Moly-Lube. This is a pulverized molybdenum disulphide, somewhat similar in its action to graphite. Tests reported by the ASME gave the following friction coefficient comparisons with a shaft rotated 10 deg and 50 deg:

	10 deg	*50 deg*
Machine oil	0.099	0.115
Graphite	0.036	0.058
Moly-Lube	0.032	0.033

Moly-Lube in a volatile solvent is applied also to de-greased bearing surfaces to minimize galling by formation of a film of 0.0002 in. thickness, functioning much like a cadmium film but without the temperature limitation. It is costly for conveyor and drive chain lubrication.

PHOTOELECTRIC COMPARATOR

(*Continued from page 102*)

Use of photoelectric comparators is most pertinent where it is desired to secure greater accuracy than is possible with visual color comparators.

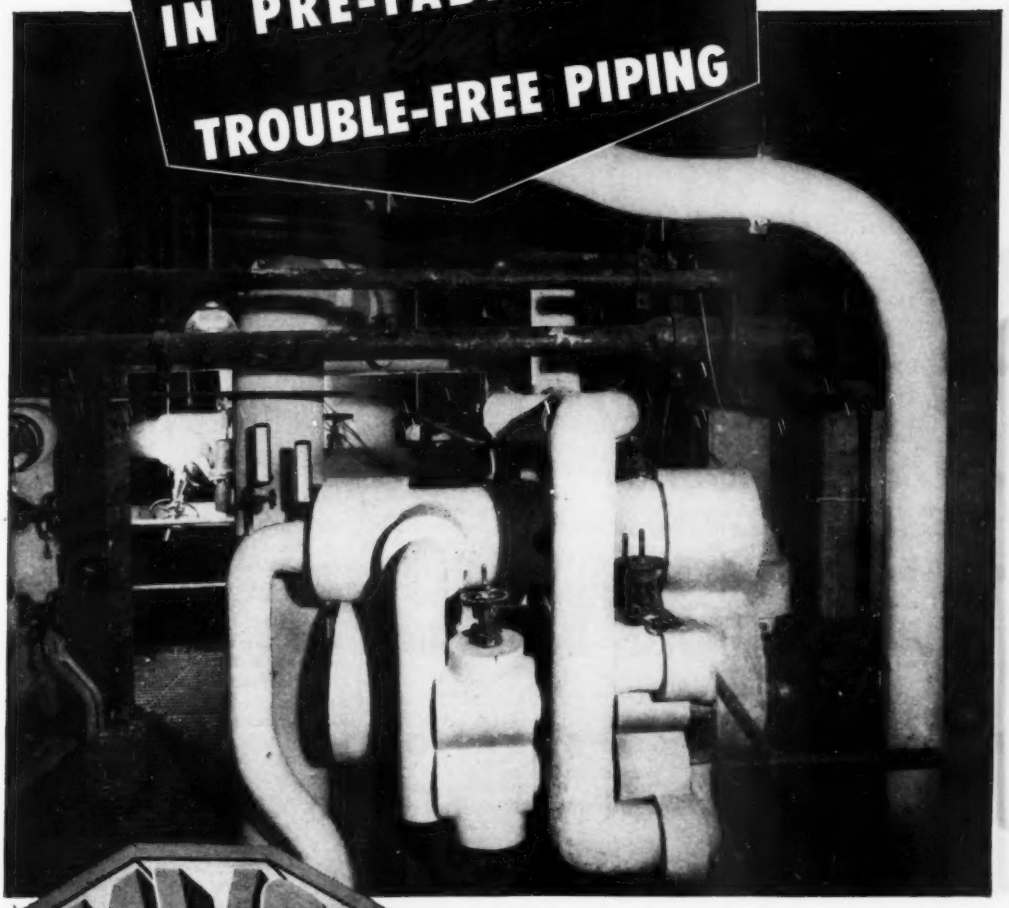
Use In Water Analysis

For example, if the phosphate content of a boiler water is controlled between 30 to 60 ppm as PO_4, the use of a conventional color comparator is satisfactory and there is no need for additional accuracy secured by a photometric method. However, where phosphate may be controlled between 3 to 6 ppm in some once-through cooling water systems or within narrow limits in some high pressure boilers, there is considerable advantage in the use of a photometric method.

Another test frequently requiring the use of a photoelectric comparator is silica. Accurate silica values in boiler water containing organic matter and phosphate require that the yellow silico-molybdate complex be reduced to the molybdenum blue color for measurement. For this method, a photoelectric comparator is required. In addition, the instrument is required to measure the small concentrations of silica that are significant.

Titrations for chromate in cooling water systems are subject to interference by various contaminants,

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



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Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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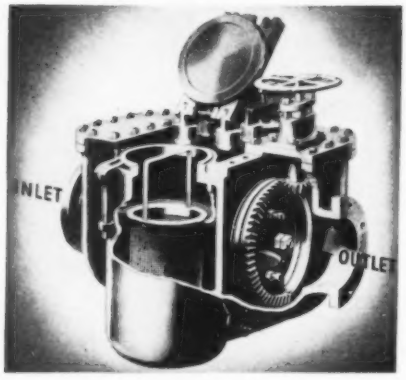
R-S Duplex Strainer



- **SINGLE HANDWHEEL CONTROL!**
  Geared turning plate is in constant contact with the seat, cannot become loose or fouled and is fully controlled by 2½ turns of the single handwheel.
- **CLEANED UNDER FULL FLOW!**
  Either of two large interchangeable basket strainers can be removed for cleaning without flow shut-off.
- **ONLY ONE STUFFING BOX!**
  Designed for minimum pressure drop and low maintenance, the R-S Duplex Strainer is available for nearly all liquids in 4-inch to 24-inch pipe sizes. Has no equal for efficient heavy industrial service.

Call your local R-S Engineer or write direct

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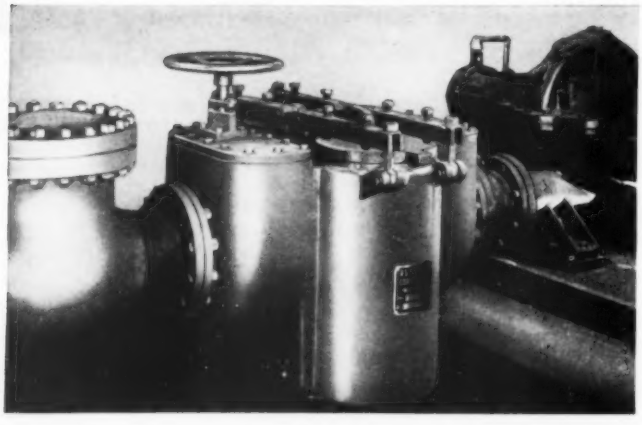


particularly those common to the petroleum industry. The diphenyl carbazide test is preferred because of its freedom from such interference. Comparator methods using this test are unsatisfactory because of rapid deterioration of the reagent. The photometric method possesses such a high degree of accuracy that, even when high dilutions of the sample are made, no appreciable error is introduced.

For those situations where small concentrations of nitrate, copper, iron and sulfate are significant, the use of photometric methods is advisable.

As new problems are encountered in water conditioning and as new methods are developed for their solution, the trend toward more precise analytical control will continue. Many analytical methods have been applied to use with photoelectric comparators and it is expected that many more will be applied in the future.

Obituaries

GEORGE W. EPPLER

George W. Eppler, General Manager of the Monongahela Division of Combustion Engineering-Superheater, Inc., passed way on June 8, 1952, at the age of 55.

A mechanical engineering graduate of Carnegie Institute of Technology, Mr. Eppler also studied at the University of Pennsylvania and Duquesne Law School. He joined Combustion Engineering in 1923 and was advanced to general manager in April, 1950. His professional affiliations included the Engineers' Society of Western Pennsylvania and the American Foundry Society. He is survived by his wife.

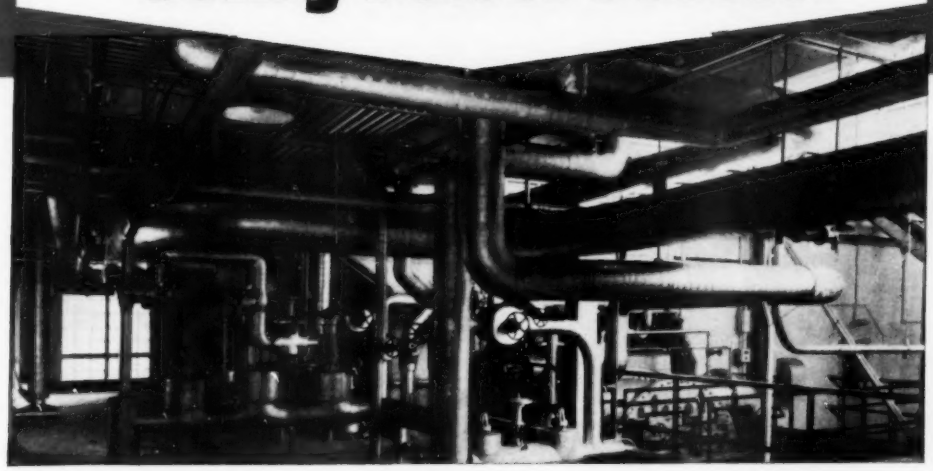
O. J. PRENTICE

O. J. Prentice, 85-year-old Chicago advertising pioneer, died July 14 in the Presbyterian Hospital of the City of Chicago. Mr. Prentice was stricken with a heart attack while attending a National District Heating Association meeting in early June at Sky Top, Pennsylvania.

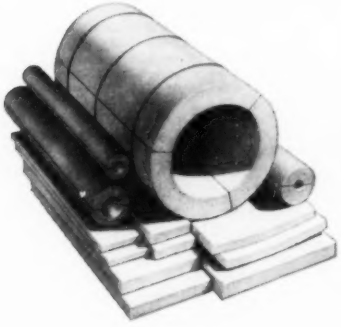
Mr. Prentice, born in England in 1867, had been in advertising and public relations work for well over half a century.

He was with Long-Critchfield & Co. (now Critchfield & Co. at Chicago) from 1894 to 1907. He was western representative for N. W. Ayer & Son, Philadelphia from 1907 until 1920 when he joined C. A. Dunham Company, Chicago heating equipment manufacturer. Mr. Prentice remained with Dunham as advertising manager until Dec. 31, 1949, when he

Insulated Better - Using Fewer Pieces



FLORIDA POWER & LIGHT COMPANY'S Sarasota Plant where Kaylo-Insulated piping delivers steam at 850 psig 900° F. Kaylo Insulation is also used at Palatka Plant, with same steam conditions . . . and specified for their Cutler Unit 4, with turbine throttle steam at 1450 psig 1000° F. Distributor-Applicator: North Bros., Savannah, Ga.



Good Reasons Why

Leading Utilities Are Switching to KAYLO HEAT INSULATION

Kaylo Heat Insulation offers advantages right down the line—in *both* performance and application.

This superior insulating material not only has an *effective* temperature range up to 1200° F., it is produced in the widest selection of shapes and sizes. With these features plus Simplified Dimensional Standards, which allow nesting, Kaylo Heat Insulation meets all operating conditions—reduces the number of pieces required per job.

Kaylo Heat Insulation is hydrous calcium silicate, *not glass*. It is insoluble in water, incombustible, and lightweight—yet strong. Easily cut and fitted, it is installed with standard tools.

For new installations or maintenance replacement, Kaylo Heat Insulation can do your jobs better . . . *at no extra cost.*

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-287, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® *. . . first in calcium silicate*

. . . pioneered by OWENS ILLINOIS **Glass Company**

MAIN OFFICE: TOLEDO 1, OHIO – KAYLO SALES OFFICES: ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

how to pack against acid

Chesterton Blu-Lon is chemically resistant to ALL acids, alkalies and caustics. Its versatility in chemical service is unparalleled. The special Chesterton Suspensoid process individually seals each strand of African Blue Asbestos with chemically inert DuPont Teflon. Blu-Lon will overcome all packing problems on chemical handling equipment. The coupon below will put you in touch with your nearest distributor.

CHESTERTON

'Blu-Lon'

Blu-Lon takes to acids like a duck to water...

Oil seals the duck's feathers; Teflon seals the asbestos strands in Blu-Lon, forming a tough, acid resisting packing.

PACKING Chesterton SERVICE

A. W. CHESTERTON CO., 6 Ashland St., Everett 49, Mass.

Please have nearest distributor give me information on Blu-Lon.

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POE

retired to go into business as an advertising consultant.

Prentice had long been prominent in business organizations closely identified with the heating field. He was a Life Member and Past President of the Illinois Chapter of the American Society of Heating and Ventilating Engineers; a member of the National Association of Building Owners and Managers; the National District Heating Association and the National Association of Power Engineers.

He became a member of the Chicago Association of Commerce and Industry in 1908, was appointed to the Illinois Committee in 1922, served one year as chairman, and was a Life Member of the Committee.

New ENGINEERING BOOKS

Radioactivity Applied to Chemistry, by Arthur C. Wahl, Editor, and Norman A. Bouner, Assistant Editor. First Edition; 604 pages; $6\frac{1}{4}$ by $9\frac{1}{4}$ in.; illustrated; cloth; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1951; Price $7.50.

In planning this comprehensive volume, the editors had two objectives in mind: to acquaint the reader with the possibilities of applying radioactivity to various fields of chemistry, and to furnish him with a comprehensive summary of the work that has been done.

As a means of accomplishing these objectives, the editors divide the book into two parts: Part I consisting of 10 chapters, covers the principles and ideas involved in the application of radioactivity to chemistry; and Part II, made up of nearly 200 pages of tables, covering factual information needed to apply the principles. This section includes data from the time of the discovery of radioactivity through 1949.

The book was written for the reader with a good knowledge of chemistry but not necessarily more than an elementary knowledge of radioactivity. It is intended primarily as a reference book, but can be used, as it is at Washington University, as the text for graduate and senior undergraduate courses in applied radioactivity.

Both editors have had extensive experience in the field of nuclear physics and chemistry. Dr. Wahl received his PhD from the University of California in 1942 and became a radiochemist for the Manhattan Project. After 4 years with the project he became Associate Professor of Chemistry at Washington University.

Norman Bouner received his PhD from Princeton University. After working at Los Alamos as radiochemist for the Manhattan Project, he came to Washington University.

General Network Analysis, by Wilbur R. LePage and Samuel Seely. First Edition; 516 pages; $6\frac{1}{2}$ by $9\frac{1}{2}$ in.; illustrated; cloth; published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y.; 1952. Price $8.00.

This book is designed to lay the foundation for most phases of network analysis, including some of the background for net-

work synthesis. The treatment is general and is intended to provide the background for advanced work in either power or communications. The subject is developed from elementary concepts, and the treatment is not slanted toward either power or communication specialists.

The material in the book can be classified into the following broad aspects; steady state in lumped networks, steady state in distributed systems, and transients in lumped networks. A number of specialized techniques that are of fundamental importance in the development of the material included. These include such topics as: matrices, symmetrical components, transmission line charts, Fourier series, Fourier integral, and the Laplace integral.

It is evident, therefore, that this is not a book for the novice. For the person with the required mathematical ability and the interest necessary to assimilate the material it is a most excellent book. Both authors have had extensive experience in teaching the subject. Wilber LePage is Professor in the Department of Electrical Engineering at Syracuse, and Samuel Seely is Professor and Chairman of the Department of Electrical Engineering at Syracuse University.

Alternating-Current Machines, by George V. Mueller. First Edition; 502 pages; 6½ by 9½ in.; illustrated; cloth; published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y.; 1952. Price $7.50.

This book is designed for an undergraduate course in a-c machines or for use by one who is beginning the study of the subject. It presents an analysis of the construction and operating principles of transformers, polyphase induction machines, synchronous machines, single-phase motors and rectifiers. An unusual number of problems and oscillograms are included, which are used to illustrate analytically and graphically the principles being discussed. Recent applications of high frequency induction motors and rectifiers are covered. The treatment is practical with a design viewpoint. The author is Professor of Electrical Engineering at Purdue University.

The New Physics, by Sir C. V. Raman. First Edition; 144 pages; 5½ by 8¼ in.; cloth; published by The Philosophical Library, Inc., 15 East 40th St., New York, N. Y.; 1951. Price $3.75.

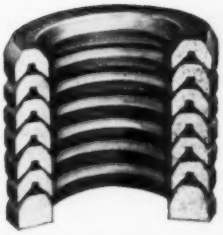
The world knows Sir Chandrashekhar Venkat Raman as one of the greatest living scientists, one of the half-a-dozen front-rank physicists—a Nobel Prize Winner and an Honorary Doctor of Science of a dozen Universities in the world. Few, however, know that he is one of the most humorous and fluent speakers in the English language.

This little book by Dr. Raman is a collection of radio talks he gave to the Indian public. Hence it is primarily of interest to the layman. In these talks he discusses those parts of nature with which all of us come in contact, but which few of us attempt to understand: water, soil, weather, atmospheric electricity, the structure of crystals and other topics. Perhaps a better idea of the scope of this splendid little book can be had from the following excerpts from the 19 chapter headings: Geometry in Nature; Light and Color in Nature; Physics of the Countryside; The Soil, The Water; Atmospheric Electricity; Modern Physical Concepts; The Solid State; The Stellar Universe.

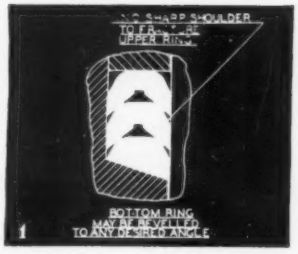
A valuable book for anybody to read.

(*Continued on page 131*)

CHESTERTON PARACHUTE PACKING



requires no gland pressure



These four figures show the complete operation of CHESTERTON Parachute Style "600" Automatic self-setting packing. Figure 1, above, illustrates the overlapping individual sealing function of each ring, the flat top and straight sides. Note how bottom ring can be shaped to individual stuffing box.

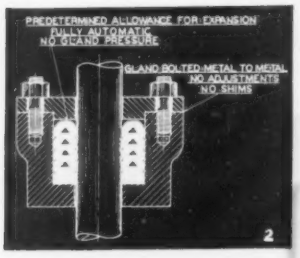
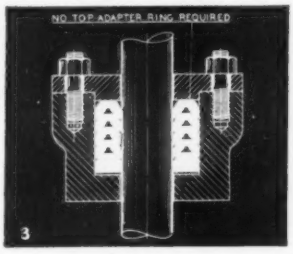


Figure 2, CHESTERTON Parachute Style "600" illustration shows proper clearance between gland follower and top ring. No gland pressure is required or desirable, as Parachute forms its own seal under pressure of medium packed.



In figure 3, CHESTERTON Parachute is illustrated under pressure. Packing has sealed automatically from pressure in force, and has moved to top of box where it is retained by gland lip.

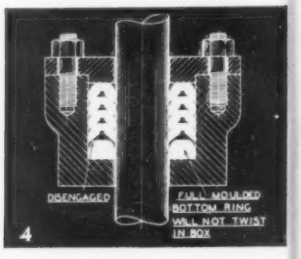


Figure 4 shows Parachute still under pressure; note that bottom non-sealing filler ring with pilot sides has dropped to bottom of box when pressure is equalized. It will not turn in box when ram is lowered.

Each Parachute ring seals individually, and due to unique design has individual lubricating channel between each ring, which assures longer wear by reducing friction. CHESTERTON Parachute will give you an entirely new packing concept. Order today, specifying 600W for water, 600S for steam, 600HO for hot oil, 600 CO for cold oil, or write for descriptive literature with complete ordering information.

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HELPFUL BULLETINS

(*Continued from page 56*)

show construction and operating details and blueprint drawings show installation methods. Binks Mfg. Co.

BOILERS, GENERATORS

132 Two-Drum Boilers — This new 16-pp bulletin describes two-drum boilers on the integral furnace type, giving information and dimensional data on company's 3-VC and 4-VC designs, both available for oil, gas or stoker firing. Typical installations for various types of firing are shown, construction details included. Erie City Iron Works.

133 Water-Tube Generators — Dimensions and design details of a water-tube steam generator are presented in 6-pp Bulletin B-3275. This is complete shop-assembled unit adapted for firing with light or heavy oils, gas, or oil and gas in combination. Operating facts discussed. The Titusville Iron Works Co.

134 Scotch Dry Back Boilers — Twelve-pp Bulletin B 111 describes a line of rugged, compact boilers in both high pressure and low pressure types. Seven installations are pictured. Leading features of these boilers are told, their efficient use of fuel stressed, and dimensions given. Dominion Bridge Co., Ltd.

COAL AND ASH HANDLING

135 Binfeed Stokers — This 8-pp bulletin describes a line of stokers, with emphasis on binfeed type. Installation photos illustrate equipment arrangement, and blueprint drawings show boiler room layouts. Retorts and accessories are also pictured and described. The drawings provided should be helpful to power engineers planning new installations, remodeling or conversion. Canton Stoker Corp.

136 Pneumatic Ash and Dust Systems — Catalog 652, 8 pp, outlines the general principles of pneumatic materials handling and the application of company's equipment. General considerations for installing such a system and the system's components are listed. Schematic shows arrangement for ash and dust handling, with explanations of component's uses. Illustrated. Allen-Sherman-Hoff Co.

137 Good Stockpiling Practice — This informative booklet, containing more than 30 pp, not only presents manufacturer's coal stockpiling and reclaiming equipment but also offers excellent suggestions on its selection and use. Tells problems to be studied when stockpiling coal and discusses some typical coal storage situations. Trends in the design of coal handling systems are also covered by text and illustration. R. G. LeTourneau, Inc.

OTHER EQUIPMENT

138 Elevated Steel Tanks — Modern water storage in elevated steel tanks is the subject of illustrated Bulletin 201, 20 pp. With some 50 installation photos, gives data on five types of tanks — double ellipsoidal, obloidal, torosegmental bottom, radial cone bottom and hemispherical bottom — in capacities ranging from 5000 to 3,000,000 gal. Includes dimension tables for each type. Accessory equipment, and new tanks for old towers discussed. Pittsburgh-Des Moines Steel Co.

139 Gas Scrubbing Equipment — Bulletin Supplement 4RA outlines various types of gas scrubbing equipment manufactured by this company. Covers applications, construction and operating features, component parts, gas scrubbing systems and a new packaged scrubber unit. Schutte and Koerting Co.

140 Carbon Steel Tubing — Technical information of value to power engineers associated with the fabrication of equipment operating at high temperatures and pressures is offered in Bulletin TDC 142. Offers condensed data on mechanical and physical properties, upsetting, swaging, flanging, expanding, bending and welding of seamless and welded carbon steel tubing. Tubular Products Div., The Babcock & Wilcox Co.

141 Portable Compressors — New literature on company's Gyro-Flo portable compressors is announced. Illustrated in color, tells how these rotary compressors work, explains design features, oil injection cooling and oil separation, and capacity control. Form 2314 describes a 105 cfm compressor and Form 2316, a 315 cfm unit. State choice of bulletin or both. Ingersoll-Rand Co.

142 Iron Castings Terminology — This 36-pp pocket-size glossary of terms explains over 150 technical words relating to ferrous and non-ferrous castings. The booklet is offered to promote greater accord in working out the procurement of satisfactory and improved castings, and should prove useful to the power engineer who purchases castings. The International Nickel Co., Inc.

143 Mechanical Vibrating Conveyors — Twelve-pp Catalog 849 presents vibrating conveyors for large, medium and light tonnages, discussing their high capacity operation, minimum maintenance and other advantages. Fully illustrated with photos of installations and parts, explains material movement. Oil-immersed drives, generally selected for use with these conveyors are described and data included on conveyor types for general, special uses. The Jeffrey Mfg. Co.

144 Gas Burner — Eight-pp Bulletin SC-1009 describes a special design of a tunnel type multiport gas burner that can be used in either furnace or open-firing applications, and is designed to operate with pressurized mixtures of any fuel gas and air. Stresses advantages of the burners, gives dimensions, capacities, construction and operating details. Selas Corp. of America.

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Catalog Library

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VALVES, TRAPS, PIPING AND ACCESSORIES

201 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

202 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

203 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all sizes of valve wheels. Babbitt Steam Specialty Co.

204 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

205 Iron Body Gate Valves — Bulletin 805, 8 pp, covers iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling applications for each. Design features are explained. Gives dimensions, working pressures, and prices. The Ohio Injector Co.

206 Blow-off Valves — Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles illustrated. Dimensions and specifications included. Yarnall-Waring Co.

207 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

208 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, stream trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

209 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers and check, gate, non-return and blow-off valves. Edward Valves, Inc.

210 Air Release Valves — Bulletin 1200, 8 pp, presents air release valves for water, sewage and industrial use. Explains essential requirements for this type of valve; illustrates methods of installation. A large cutaway drawing accompanies discussion of the operating and construction details. Standard high pressure and special types described, dimensions given. Simplex Valve & Meter Co.

211 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are in 12-pp Bulletin 477-A. Northern Equipment Co.

213 Steam Trap Book — Catalog J is the 44-pp new edition of this company's popular trap book and serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

214 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be

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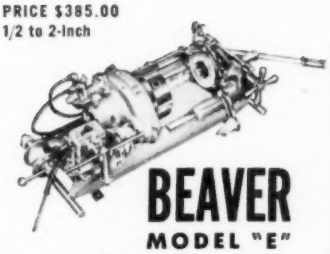

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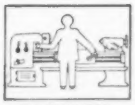

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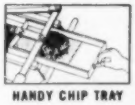

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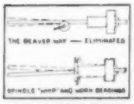

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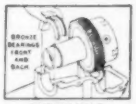

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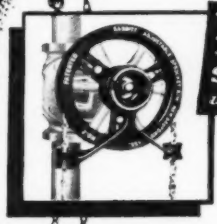

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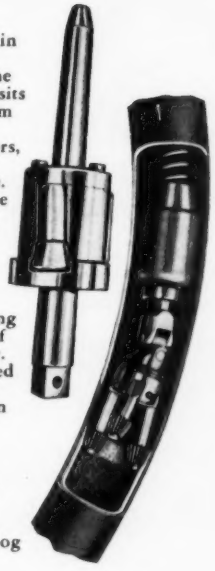

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215 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline as well as piston-operated steam traps. W. H. Nicholson & Co.

216 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

217 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

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218 Duplex Strainer — This literature describes company's Duplex strainer with single handwheel control. Shows how it is designed with only one stuffing box and can be cleaned under full flow. R. S. Products Corp.

219 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Available to qualified power engineers; please give your title. Henry Vogt Machine Co.

220 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

221 Flanges for Severe Service — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

222 Design Properties of Pipe — This 12-pp booklet consists of tables listing pipe sizes and wall thicknesses currently established as standard, plus dimensional properties of commercially available sizes of steel pipe. Tube Turns, Inc.

223 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

PUMPS AND COMPRESSORS

225 Centrifugal Pump Handbooks — Two instruction booklets covering the installation, operation and repair of company's single-stage single-suction and multi-stage centrifugal pumps are available. Suggest regular inspection procedures and include pages for maintenance records. Also provide handy tables explaining how to locate trouble and listing causes and cures. Bulletin 08X7813, 24 pp, covers single-stage pumps; Bulletin 08X7780, 48 pp, covers the multi-stage pumps. State choice or both. Allis-Chalmers Mfg. Co.

226 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data, vapor pressure tables included. Pacific Pumps, Inc.

227 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Worthington Corp.

PACKINGS, GASKETS, SEALS

228 Manual on Packings — Containing 84 pp of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts,

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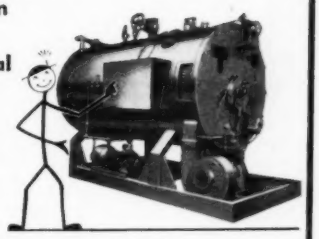

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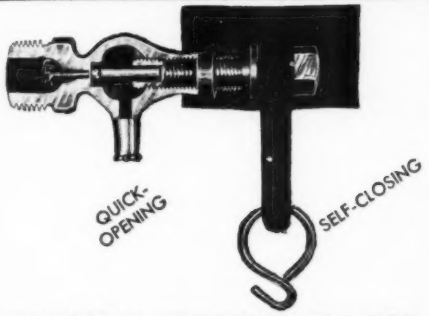

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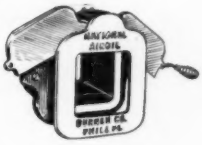

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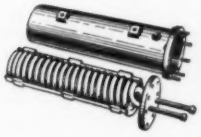

The "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil & Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation. May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

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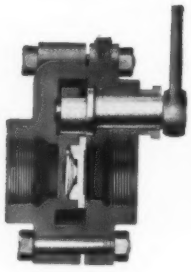
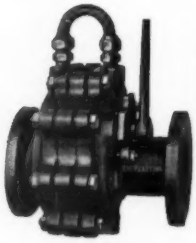
Wherever frequent use and quick operation is required for any liquid or gas at pressures up to 300 psi. These valves have outside stuffing box and gland.





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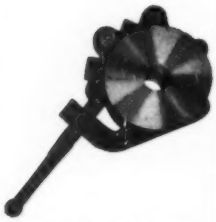
Quick-opening, also handwheel operated, angle and "Y" types and combination units meeting ASME Code requirements for pressures up to 600 psi.



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conversion tables. The Belmont Packing & Rubber Co.

229 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

230 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with photos and construction information, sizes, etc. Packings and gaskets are grouped according to recommended applications and services. Johns-Manville.

231 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

232 To Pack Against Acid — A packing that is chemically resistant to all acids, alkalies and caustics is described in this literature. Tells how packing incorporates both asbestos and Teflon in its construction, stresses advantages. A. W. Chesterton Co.

COAL, ASH HANDLING

233 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

234 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

235 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

236 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

REFRACTORIES, INSULATION

238 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also provides information on a fused aluminum brick. Norton Co.

239 **Heat Insulation** — This 8-pp booklet on hydrous calcium silicate insulation is illustrated with graphs, tables and drawings showing the numerous ways in which this insulation is used in industrial and commercial projects for temperatures up to 1200 F. Lists wide selection of shapes and sizes to insulate tubes and pipes from $\frac{1}{4}$ to 72 in. dia and vessels from 72 in. to 60 ft, also flat surfaces. Gives data on physical characteristics, recommended thicknesses. Kaylo Div., Owens-Illinois Glass Co.

240 **Heat Insulation Data** — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

241 **Industrial Insulations** — Selection and application information on insulating materials is presented in this 28-pp illustrated catalog. Covers block and blanket insulations, insulating cement, low pressure coverings, felt, other products. Gives specifications, temperature ranges, recommended thicknesses, prices, Baldwin-Hill Co.

FUEL BURNERS

242 **Gas Burners** — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each type. Coppus Engineering Corp.

243 **Steam Atomizing Oil Burners** — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc.

244 **Oil Burning Equipment** — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

FUEL OILS, LUBRICANTS

245 **Cooperative Technical Consultation Service** — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

246 **Air Compressor Lubrication Manual** — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

247 **Lubrication of Diesel Engines** — An excellent instruction manual, 50-pp Technical Bulletin B-1 (revised)

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also provides a brief history on diesel engines, an explanation of the fundamentals of design and the common types of diesels and their advantages. Explains combustion process, discusses modern fuel injection systems. Cylinder and bearing lubrication are treated and recommendations given for lubricating oils. Sun Oil Co.

248 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. The De Laval Separator Co.

249 Versatile Industrial Oil— Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

BOILERS, GENERATORS

251 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed along with wide range of applications. Capacities, dimensions and weights are given along with efficiency data. The Babcock & Wilcox Co.

252 Steam Generator — Bulletin 1050 describes a fully automatic generator in 10 to 500 hp capacities furnished completely equipped ready for installation. Cutaway drawing illustrates design of the unit; major parts are discussed, full dimensions included. Lists fuel burning equipment provided for use with light and heavy oils, gas, or combinations. Ames Iron Works.

253 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Combustion Engineering-Superheater, Inc.

INSTRUMENTS AND CONTROLS

254 Pressure Regulator — Bulletin 1-B, 8-pp discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve. Atlas Valve Co.

255 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board

Use postage-free cards on pages 36 and 118 to order these catalogs. Just list item numbers of those you want.

arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

256 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

257 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

258 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

259 For Combining Control Signals — The improved design of company's Ratio Totalizer is described and pictured in color in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp.

260 Steam Calorimeter — Bulletin 118 discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of the unit. Ellison Draft Gage Co., Inc.

261 Fundamentals of Instrumentation — Booklet 80-2 offers 126 pp of information on instrumentation in industry. Separate sections are devoted to the fundamentals of measurement and control, measurement of process variables, remote transmission of measurements, automatic controllers, power units and final control elements, control systems and panel-boards. Typical applications are also discussed. Generously illustrated. Available to qualified power engineers. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

262 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

263 Temperature Instruments — This 100-pp catalog gives details about company's complete line of industrial glass, dial and recording thermometers, electronic temperature indicators and recorders. Fully illustrated, includes application information. American Industrial Instruments, Manning, Maxwell & Moore.

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265 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, having helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

266 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

WATER CONDITIONING

267 Chlorination for Power Plants — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the deslming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Wallace & Tiernan Products, Inc.

268 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes equipment. Dearborn Chemical Co.

269 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of this system is provided. Worthington Corp.

270 Carryover Prevention — Eight-pp Technical Paper 115 discusses the role of anti-foam agents in the prevention of carryover of boiler water solids with steam. Covers mechanical and chemical influences on carryover, foaming and anti-foam action, types of anti-foam agents. W. H. & L. D. Betz.

271 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

272 What's New on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

273 Modern pH and Chlorine Control — This 100-pp booklet gives details on color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

274 Organics in Water Treatment — Here's a folder describing need for organics in altering nature of sludge to make it non-adherent. Covers theoretical and practical considerations involved in use of organics. Power Chemicals Div., E. F. Drew & Co., Inc.

275 New Data on Zeolite Softeners — Publication 4520-A is a recently revised edition of company's booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of zeolite materials and discussion of the four stages of operation of a sodium zeolite softener. Cochrane Corp.

276 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on

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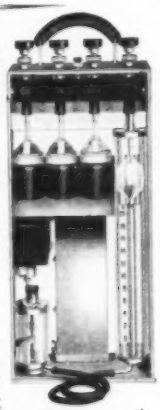

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a demineralizing plant are given. Graver Water Conditioning Co.

277 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system telling results to be expected. No. 28X4766 discusses current status of embrittlement in boilers, explaining causes and control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

278 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

279 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (the Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing special chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

TOOLS

281 Pipe Tool Book — This catalog and data book gives information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes "operating guide" Beaver Pipe Tools.

282 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

283 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

OTHER EQUIPMENT

284 Friction Tape — Three types of friction tape are described as to properties and application in Form M-8343. They include a high grade tape for all electrical work, a good general purpose tape that's competitively priced and available in two widths, and an extra strong tape. United States Rubber Co.

285 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

286 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

287 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water. Foster Wheeler Corp.

288 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Included scales of total heat losses of various types of fuel. The Hays Corp.

289 Magnetic Drive Engineering Data — Publication 1107 is a 32-pp booklet on precision speed control with adjustable speed magnetic drive. Technical in scope contains information on both magnetic drive and company's magnetic amplifier Regutron speed control. Data is clarified through charts and diagrams. Electric Machinery Mfg. Co.

290 Spray Nozzle Systems — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-SP. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included. Schutte and Koerting Co.

291 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

292 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors, controls is provided. Westinghouse Electric Corp.

293 Synthetic Coatings — Specially engineered coatings for use in pump rehabilitation, condenser tube and sheet protection, valves, concrete, steel and transite piping, and condenser sealing are discussed in illustrated bulletin. Also describes an acid-proof coating for cooling tower structures. Synco Corp.

Postage-free cards for ordering catalogs and bulletins are provided on pages 36 and 118

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New Books—

Transients in Power Systems, by Harold A. Peterson. First Edition; 361 pages; illustrated; 6 by 9¼ in.; cloth; published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1951. Price $6.50.

This book was written primarily for individuals responsible for power system and apparatus design, but it should also be of use to students in engineering colleges who may wish to use it as a reference for advanced study in circuit phenomena.

Much has been learned about electric transient phenomena during the last several decades. The pioneering work of men like Steinmetz and Heaviside was notable as a means of achieving a clearer understanding of transient phenomena, and their methods of analysis can be applied to linear circuits without reservation. As circuits become more complex, however, or as the switching sequence to which a circuit is subjected becomes more complex, the application of these methods becomes laborious and time consuming.

As the author points out, during the past decade, new tools were developed and put to use in studying many of the circuit transient phenomena previously avoided because of the prohibitive amount of time required for arriving at their solution. These tools are the differential analyzer and the transient analyzer. Both of these devices have been found useful in reducing the time and effort required to analyze these more complex circuit problems.

While the application of these analyzers has been described in various papers in the *Transactions of AIEE*, the material is scattered throughout the literature. Furthermore much of the work done has not been published. Consequently it is largely the object of this book to organize and consolidate the information contained in these numerous publications, as well as much of that which has not been published. The coordination and integration of this material will enable the apparatus designer to more readily avail himself of the knowledge pertinent to his particular responsibility.

Power System Engineering is becoming of increasing importance as systems grow in extent and capacity and as interconnections become more numerous. This book, therefore, fulfills a need that has been growing in extent and importance.

Industrial High Frequency Electric Power, by E. May. First Edition; 355 pages; 5½ by 8¾ in.; illustrated, cloth; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1950. Price $5.00.

For the reader who is interested in applying high-frequency heating to industrial problems, this book will serve as an excellent introduction. From basic circuit theory to operating problems, it provides a concise summation of basic facts in this growing field. It is well suited to give inexperienced people in the industry a source of basic facts and instruction on how these facts can be used as a guide to specific heating performance. Among other things, Dr. May gives an excellent summation of the a-c theory involved in tuned and coupled circuits, a brief discussion of arc and spark oscillators, a description of high-frequency alternators, discussion of the triode tube and Class B and C amplifiers, induction and dielectric heating. It is a well-organized book and one that should be useful to those concerned with high-frequency electric power.

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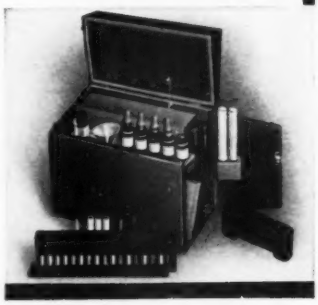

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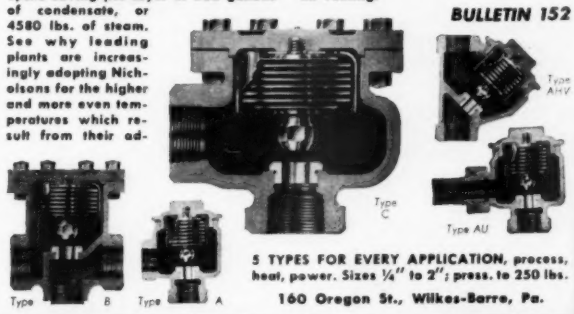

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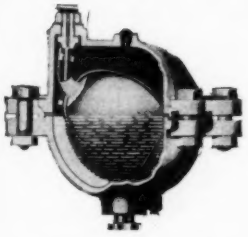

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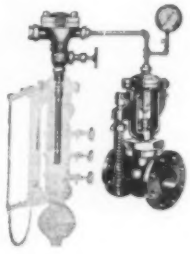

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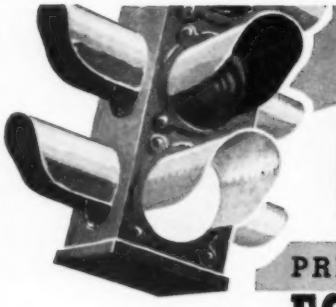

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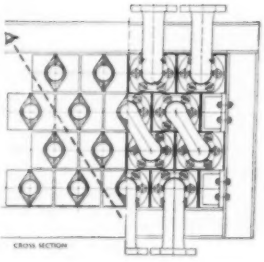

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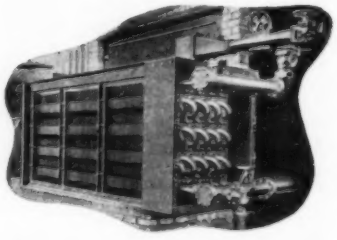

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(*Continued from page 115*)

Writing for Business, by C. W. Wilkinson, J. H. Menning, and C. R. Anderson; First Edition; 347 pages; size 6 by 9¼ in.; cloth binding. Published by Richard D. Irwin, Inc., 1818 Ridge Road, Homewood, Ill. Price $4.00.

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White Collar, by C. Wright Mills; 378 pages; size 5½ by 8½ in.; cloth binding. Published by Oxford University Press, Inc., 114 Fifth Avenue, New York 11, N. Y. Price $5.00.

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Heating Design and Practice, by Robert Henderson Emerick; First Edition; 453 pages; illustrated; size 6¼ by 9¼ in.; cloth binding. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd Street, New York 18, N. Y. Price $8.00.

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Piping Design and Engineering; First Edition; 221 pages; illustrated; size 8¾ by 11¼ in.; cloth binding. Published by Grinnell Co., Inc., Providence, R. I. Price $10.00.

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Selling to Industry, by Bernard Lester; First Edition; 255 pages; size 4¾ by 7 in., leather bound. Published by The Industrial Press, 148 Lafayette St., New York 18, N. Y. Price $3.50.

Engineer's Illustrated Thesaurus, by Herbert Herkimer; 572 pages; size 5½ by 8 in.; illustrated; cloth bound. Published by Chemical Publishing Co., 212 Fifth Avenue, New York, N. Y. Price $6.00.

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Heating Ventilating Airconditioning Guide 1952; 30th Edition; 1496 pages; size 6 by 9 in.; illustrated; cloth bound. Published by the American Society of Heating Ventilating Engineers, 62 Worth St., New York 13, N. Y. Price $7.50.

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Exhaust Hoods, by J. M. Dalla Valle; Second Edition; 146 pages; illustrated; size 6 by 9 in.; cloth binding. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $3.50.

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All-Purpose Diesels, by J. Malcolm Robson with a chapter by C. A. Pickering; 316 pages; illustrated, size 6 by 9 in.; cloth binding. Published by Pitman Publishing Corp., 2 West 45th Street, New York 36, N. Y. Price $10.00.

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Industrial Heat Transfer, by F. W. Hutchinson; 326 pages; illustrated; size 6 by 9 in.; cloth binding. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $6.00.

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Nomography and Empirical Equations, by Lee H. Johnson; 150 pages; size 6 by 9 in.; illustrated; cloth bound. Published by John Wiley and Sons, Inc., 601 West 26th St., New York 1, N. Y. Price $3.75.

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Cooling Towers, by J. Jackson; 104 pages; illustrated; size 5½ by 9½. Published by Butterworth Scientific Publications in association with Imperial Chemical Industries Limited. Copies obtainable from Butterworth & Co. Ltd., 1367 Danforth Avenue, Toronto 6, Ontario, Canada. Price $3.50.

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REPUBLIC
INSTRUMENTS
AND CONTROLS

Do You Know About ALL of the **REPUBLIC** *Line?*

Check the Republic line of measurement and control equipment listed below. You'll find instruments and controls to meet your needs—whether for a simple control or an automatic control system. And teamed with this equipment is an experienced engineering staff which can give you the right answer to your measurement and control problems.

☐ **ELECTRICAL FLOW METERS.** For metering the flow of steam, water, gas, air, oil, brine, etc. The reading instruments, indicator, recorder and integrator, are remote reading and can be supplied singly or in any combination desired. Integration is continuous, an exclusive Republic feature.

☐ **PNEUMATIC TRANSMITTERS.** For converting process variables such as flow, liquid level, pressure, or liquid density into air pressures which vary proportionally with the process variables. These air pressures can be used as a measuring impulse for the actuation of an automatic controller or a direct reading recorder.

☐ **CO_2 METERS.** Provide a continuous record of percent CO_2 in flue gas measured by the Orsat method. Furnished with either mechanical or electrically actuated remote reading indicator and recorder.

☐ **DRAFT INSTRUMENTS.** Indicating or recording types in single or multiple units. Furnished in all standard ranges of draft and pressure.

☐ **THERMOMETERS.** A long distance, gas filled thermometer with either single or multiple pen recorder.

☐ **LIQUID LEVEL INSTRUMENTS.** Remote reading indicators and recorders. Also provided with various types of alarm devices.

☐ **MULTI-POINT INDICATORS.** Will indicate, on separate vertical scales from two to sixteen units of draft, pressure, flow, temperature, CO_2, etc., in any combination desired.

☐ **MULTIPLE RECORDERS.** Strip Chart Type will record from three to six separate records of flow, temperature, CO_2, pressure, etc., in any combination desired. Round Chart Type can have up to 4 pens.

☐ **REGULATORS.** For the automatic control of pressure, draft, rate of flow, rate of fuel feed, speed of rotation, liquid level, etc. For proportioning two pressures or flows. Regulators may be either air or oil operated. Flexibility in design and construction allows the regulator to perform any type of control action. Setting may be remote or manual.

☐ **AUXILIARY RELAYS.** Multiplying, dividing, adding, subtracting, maximum and minimum setting, ratio, ratio computing, sequential, splitter, squaring, square root extracting, and position indicating.

☐ **COMBUSTION CONTROLS.** A centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler level, etc. Automatically regulates the fuel and air input to a boiler in measured proportions and in a fixed ratio for the entire load range. Adaptable to multi-fuel firing.

☐ **DESUPERHEATERS.** Atomizing type desuperheater uses a small quantity of high pressure steam to vaporize an automatically controlled amount of water in reducing steam temperature to the desired degree.

☐ **VALVES—REGULATING AND PRESSURE REDUCING.** Designed and built for all practicable ranges of pressures with either flanged or welded ends. Special body design sharply reduces erosion and noise. Cylinder operated valves available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in. Republic valves are built in accordance with A.S.A. Standards for all pressures up to 2500 psi. Diaphragm operated valves are available for pressures from 125 to 1500 psi and from 3 in. to 10 in. in size. Special purpose alloy steel butterfly valves in sizes 4 in. to 24 in. are also available.

Data Books are available on any of the above equipment

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway • Chicago 47, Illinois

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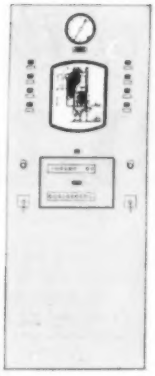
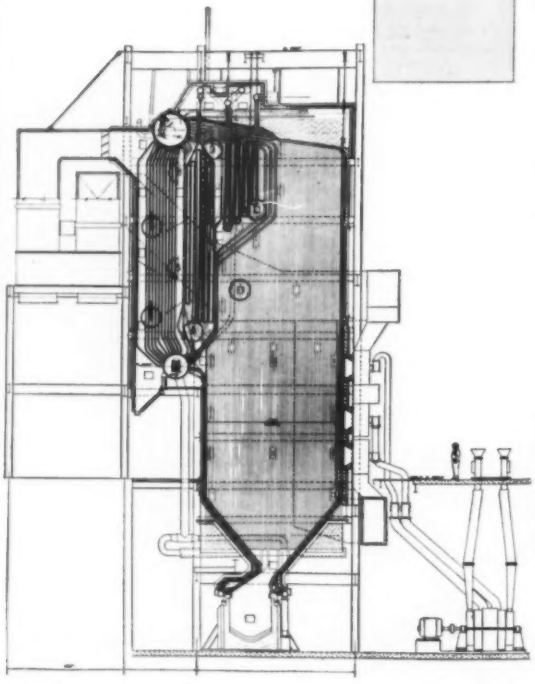
VULCAN ALL-ELECTRIC, AUTOMATIC SEQUENTIAL SYSTEM on ALBRIGHT STATION'S OUTDOOR BOILERS

Operator at the panel needs only to push a button to start the Vulcan Automatic Sequential soot blowing. He can interrupt and select any one or more stations for repeat blowing or cut-out—or remote push button control may be used. No need to patrol the boiler, for each unit reports back to panel by indicating light.





Built at Albright, West Virginia, by Monongahela Power Company and The Potomac Edison Company, Albright Station will have its two new outdoor boilers cleaned by an all-electric Vulcan Automatic Sequential System. All-electric drive means cleaner, more dependable operation. There will be no danger of freezing in control-air lines to the outdoor blowers.

If you want effective, low-cost cleaning of your boilers—large or small, utility or industrial, power or process—depend on Vulcan. The oldest name in soot blowing will give you the latest word in results.

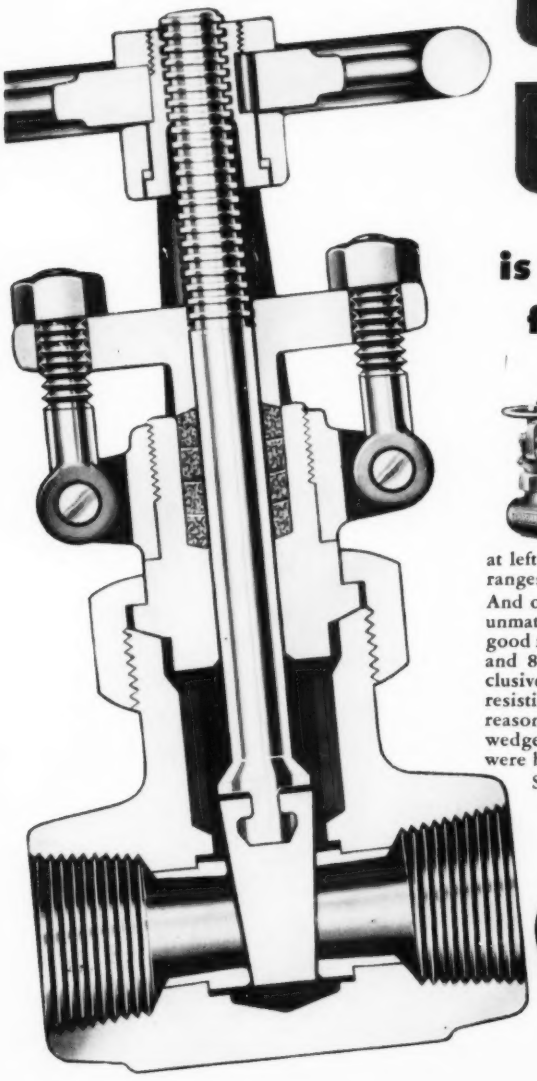
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

Capacity, each of 2 Boilers	770,000 lb per hr
Superheater Outlet Pressure	910 psi
Superheater Outlet Temperature	905 F
Fired with	Pulverized coal
Soot Blowing	Vulcan Automatic Sequential System with long retractables, wall blowers and controls for air-heater cleaners. Electric drive. Blowing medium: Steam.
Engineers	Sanderson & Porter

VULCAN Automatic Soot BLOWERS

You don't have to look it up...

CHAPMAN LIST 960



is the RIGHT NUMBER for any number of different jobs

No other small valve has as big a field of application as this Chapman List 960 Forged Steel Gate Valve. You can get it in sizes from ¼" to 2", with joints either gasketed or metal-to-metal . . . and in 2 types: Rising stem with yoke, as shown at left . . . or rising stem with inside screw. Pressure ranges from 2,000 lbs. at 100° F, to 380 lbs. at 1,000° F. And on *any* job, Chapman's List 960 shows the same unmatched ability to take it . . . and stay with it. One good reason is that hard faced Stainless steel seat rings and 800 Brinell hardening of gate faces by the exclusive Malcomizing Process, provide maximum wear-resisting and non-galling properties. And still another reason is that changes in design have made stem and wedge gate connections 50% *stronger* than they ever were before.

So if you want the biggest savings you ever got from a small valve, *specify Chapman List 960.*

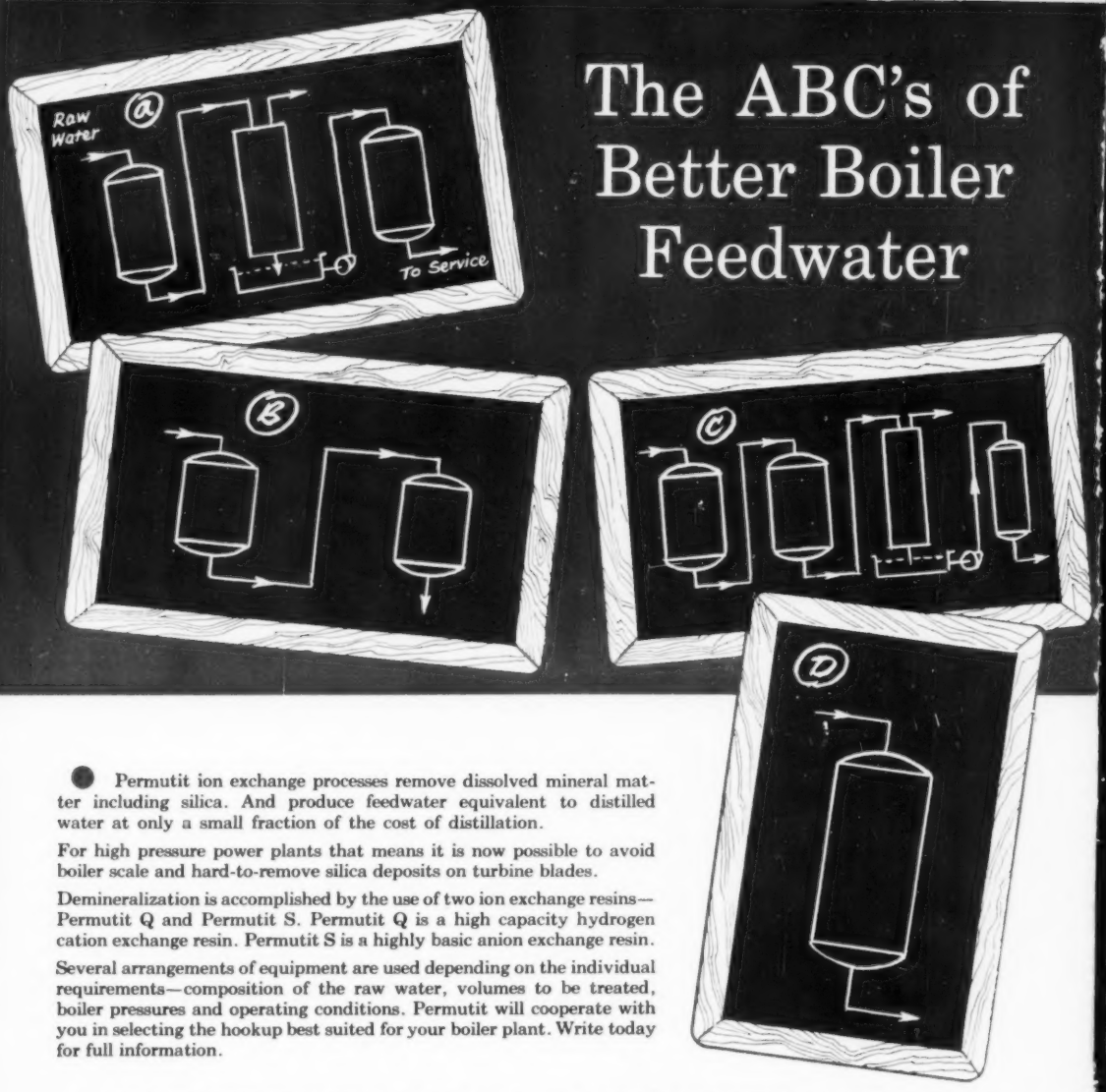
THE

CHAPMAN

VALVE MFG. CO.

INDIAN ORCHARD, MASS.

The ABC's of Better Boiler Feedwater



Permutit ion exchange processes remove dissolved mineral matter including silica. And produce feedwater equivalent to distilled water at only a small fraction of the cost of distillation.

For high pressure power plants that means it is now possible to avoid boiler scale and hard-to-remove silica deposits on turbine blades.

Demineralization is accomplished by the use of two ion exchange resins—Permutit Q and Permutit S. Permutit Q is a high capacity hydrogen cation exchange resin. Permutit S is a highly basic anion exchange resin.

Several arrangements of equipment are used depending on the individual requirements—composition of the raw water, volumes to be treated, boiler pressures and operating conditions. Permutit will cooperate with you in selecting the hookup best suited for your boiler plant. Write today for full information.

A **TWO STEP WITH DEGASIFIER:** In large demineralizing plants, a degasifier is usually included as an inexpensive means for removing carbon dioxide.

B **TWO STEP WITHOUT DEGASIFIER:** No repumping required. Used where total quantities are not very great or with waters of low bicarbonate content.

C **THREE STEP WITH DEGASIFIER:** Extremely economical and effective arrangement for waters containing relatively high amounts of sulfates and chlorides.

D **MIXED BED:** An extremely compact arrangement. Both cation and anion exchangers are in the same unit. Used alone or as a final step.

The equipment described is also furnished in multiunit arrangements to treat whatever quantities of water are required and to meet all operating conditions.

PERMUTIT®

The sole manufacturer of all types of cation and anion exchangers and equipment.
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330 West 42nd Street, New York 36, N. Y.

Permutit Company of Canada, Ltd.,
6975 Jeanne Mance Street, Montreal.

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS